EDITORIAL

WITH feelings of profound regret we record the death of H. W. Baker, who has been connected with the staffs of WESTERN ENGINEERING and the *Mining and Scientific Press* for many years.

TOTAL receipts of 52 out of 58 counties of California for 1914 were $84,419,199.51, of which $14,459,488.23 was from the sale of bonds. The total disbursements were $75,303,110.95.

INDEX for the fifth volume of WESTERN ENGINEERING is now ready for distribution and will be mailed to all those who desire to have their back numbers bound. Drop a line to the circulation manager and the index will be sent by return mail.

OF the sum of $15,036,798.12 to be contributed in 1915 by the California corporations toward the expenses of the State government, $8,872,185.16 will be paid by the steam and electric railroads, and the light and power companies.

WHILE the cost of most metals has risen since the outbreak of the War, the Federal Bureau of Mines is now producing radium at a cost of $36,000 per gram, as against a selling price last year of from $120,000 to $160,000 per gram. Nevertheless, most of us will wait a little while longer before making our purchases.

FREIGHT-RATES on oil to Arizona points have been reduced approximately 50 cents per ton, by order of the Interstate Commerce Commission. While this is good news for the Arizona consumer, the California producer is not likely to find his market appreciably increased, for nearly all the fuel-users in that region already burn oil exclusively.

WATERS of California lakes may be appropriated in the same manner as those of a flowing stream or a spring, according to a decision recently received from the Department of the Interior. Because of a misapprehension regarding the California law and the court decisions thereon, the Department has held in the past that the water of a lake was not subject to appropriation. This decision is now reversed.

WESTERN Oil Producers Association has been organized among the oil-men in the Kern County oilfields, with the object of presenting before Congress the claims of those companies affected by the Government withdrawal orders. While such operators are the only ones that are likely to benefit directly from the activities of the Association, the membership includes a large number of the companies in the fields.

WATER-TROUBLE of different kinds has been a prominent source of annoyance to the races of men for many years. King Canute was one of the first to point out the difficulty of getting the ocean under any kind of control. Hardly less difficult is the task undertaken by Mr. Howard M. Payne, recently appointed Federal receiver for a number of Kern County oil companies affected by the withdrawal orders, namely, to eliminate water-trouble in the oil-wells on the Maricopa flat. While there is no possibility that this can be completely accomplished, nevertheless, with the most seriously affected companies under Mr. Payne's control, and with the assistance of the Maddux bill, the general situation can be greatly improved. The uncertainty of tenure had made several of the companies rather lax in the administration of their properties just prior to the commencement of the Government's suits. Should the ultimate decision of the courts be in their favor, some operators may have reason to be thankful that a receiver was appointed in time to save their properties from being completely ruined by water-infiltration.

RAISING money for road-maintenance without burdensome increase in taxation is the problem that is confronting many communities today. The latest solution to be suggested comes from Yuba county, California. A farmer in that region proposes that the county plant olive trees along the right-of-way, with the expectation of reaping enough profit when the trees come into bearing to provide funds for keeping the roads in repair. Probably the small boys of the community would favor planting a tree having a more palatable fruit than the olive when fresh-picked, but we presume that they will not be consulted. The experience of olive-growers in particular and orchardists in general seems to indicate that even when the land is devoted to crop-growing alone and all other conditions are subordinated, no extravagant profits are obtained. Where, however, the necessity of keeping the road open and in good condition for travel takes precedence over raising a profitable crop, chances for a 'red-ink' balance would become much greater. The roadmaster will probably have to look to the tax-collector for maintenance-funds for some time to come.

CIVIL-SERVICE examinations have, as one of their principal objects, the elimination of the unfit. While no one pretends to believe that this object is completely accomplished, it is undoubtedly true that the general effect is better than with any other system. However, there is danger sometimes that this process of elimination may be followed until many of the fit are

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also rejected. In some cases questions are given on topics that are still familiar to the man recently graduated from college, but which the engineer of several years' experience has forgotton. In other cases, insistence on a particular kind of experience has operated against the appointment of competent men. There have been instances where it was impossible to obtain a sufficient number of applicants that could show the required experience. Temporary appointments had to be made from outside the eligible list and when the time limit on these appointments had expired, other equally inexperienced men had to be appointed temporarily, notwithstanding the fact that the first appointees were doing satisfactory work. Such conditions, besides resulting in unnecessary hardship for competent men, manifestly demoralize the service. It should be possible to allow considerable discretion in appointment to those in direct charge of work, while at the same time guarding against all favoritism.

SAN DIEGO has adopted the city manager plan, Mr. Fred M. Lockwood having been appointed to fill this position following the adoption by the electors of the new method of city government. Mr. Lockwood has promised the citizens to issue monthly statements to any or all citizens who may ask for them. These statements are to be prepared according to the procedure ordinarily obtaining among large corporations and are to be, it is hoped, comprehensive and illuminating. Statements concerning the conduct of any municipal enterprise are to be supplied in detail to any voter applying for this information at the city hall. A preliminary report and the first regular monthly report have already been issued. Apparently some change in the management of the affairs of the city was needed. The preliminary examination showed that there was a good deal of uncertainty as to the condition of the funds available for the various departments, in one case the department's books failing to balance with the auditor's books within twenty thousand dollars. Nevertheless, at least two departments had already drawn on the available revenue to such an extent that a loan from the general fund for their benefit will be required before the end of the year. A number of economies have been effected in management that may help to save the situation this year as well as lessen the danger of the recurrence of a similar condition in the future.

SEE the doctor before the funeral. The former may obviate the necessity for the latter. This is no abortive attempt at humor, but is advice given with serious intent. Unfortunately, the necessity for pointing out the advisability of this obviously logical course is born of the procedure that has been pursued by several California counties with respect to their road construction. Attention has been directed in these columns to the course followed by the highway commission of Kings county, in which specifications and other matters requiring a high degree of technical knowledge were adopted without the services of an engineer. And now it is reported that the highway commission of Fresno county is about to make several momentous decisions as to the specific roads to be improved as a part of the county highway system before going through the formality of appointing an engineer. These comments are made with the utmost respect for the commission, both personally and collectively. The whole road question, we submit, is one calling for an engineering specialist, and is not a job for the layman to undertake, regardless of how successful his commercial career may have been. It should not be forgotten that it is easier to make changes and alterations on paper than after the road has been completed. An engineering study, based on a reconnaissance, traffic census, and a knowledge of soil, drainage, and other conditions is the best possible foundation upon which to erect improvements that will at least be of sufficient permanence to live as long as the period of the bonds. It is said that the man who is his own lawyer has a fool for a client. And what is the highway commission which has no engineer at all? Perhaps this question will be answered by the next generation, which will have to pay many bills incurred by the present.

FREQUENTLY these columns have been given to protest at the tendency to intrust the administration of technical affairs to laymen, the more prominent the occasion the more violent the protest. We have before us the latest answer of the Secretary of the Navy to his many critics. This answer has taken the form of the appointment by the Secretary of a sort of 'Advisory' board, which is supposed to examine and report upon inventions that may be of value to the United States Navy. The board is headed by Mr. Thomas A. Edison, followed by Mr. Henry Ford, and well flanked by names equally prominent in commercial circles. We are frankly puzzled to understand just what the function of this Board is, what it is expected to accomplish and how. Even the most unthinking unit of the American public appreciates that naval science in all of its many ramifications is highly technical in its nature, and that the gentle art of killing one's fellow man in the most expeditious manner and for the lowest unit cost possible is somewhat at odds with the manufacture of talking machines and popular priced automobiles. Outside of its possible effect in restoring the present Secretary of the Navy to popular favor, we can see no constructive benefit in the appointment of an advisory board to 'butt' as it were, into a science about which they know nothing, and thereby ignore the recommendations of the officers of the navy, who have given their lives to the service with no hope of reward apart from the recognition of good work well done. An American manufacturer of technical apparatus, say, who, with a competent and highly trained engineering corps at his disposal, should call in a most excellent insurance solicitor for the purpose of passing upon the designs for a machine would afford material for a vaudeville skit. In the case in point, however, the daily press seems to see the comedy element without assistance.

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REVIEW OF THE MONTH

SPECULATION as to the financial condition of the Panama-Pacific Exposition has been set at rest through a statement recently issued by the directors and certified by a well known firm of public accountants. While in April and May the elements conspired to make the Exposition grounds anything but pleasant and thereby caused a deficit for that time, nevertheless the five months' period during which the Exposition gates have been open show a net profit in receipts over expenditures of something over $180,000. The summer season is now on and the influx of visitors from the outside has commenced in real earnest. There seems little doubt at present that the Exposition will be able to pay its way until December without calling upon the stockholders for further contributions.

JITNEY regulation usually includes a provision for carrying an indemnity-bond by the operator, to protect both the occupant of his car and the pedestrian in case of accident. Portland, Oregon, however, has gone a step farther and is attempting to prevent the occurrence of the accidents that have been the worst feature of jitney operation. Before receiving a license, drivers are to be examined carefully as to their ability to handle a car, and the cars themselves are to be inspected once a month. While an automobile can get in pretty bad shape during the course of a month, as some of us know to our cost, nevertheless even a monthly inspection will materially decrease the number of actually unsafe cars in operation.

ECONOMY of permanent construction has been recognized by the directors of the Modesto irrigation district. The main canal as originally constructed, at a time when first cost was necessarily kept as low as possible, included several long flumes across deep gulches. Some of these have recently been replaced by concrete structures or earth fills, and work is now under way on the others. Scarcely less important in the aggregate is the decision to build concrete headgates for all lateral ditches in place of the present wooden structures. This will not only reduce the expense for repairs and renewals to a minimum, but also effect a considerable saving of water, an increasingly valuable commodity throughout the State.

GOOD-ROADS sentiment in Oregon is increasing rapidly. In 1913, the legislature passed an act creating the state highway commission and providing for the construction of roads by the counties with its co-operation. Several counties took advantage of this opportunity and commenced the construction of permanent highways within their own boundaries. In Multnomah county, the now-famous Columbia highway was constructed under the direction of Mr. John B. Yeon, and the results of this work were so satisfactory that in June last the county voted bonds for $1,250,000 for the construction of 70 miles of hard-surfaced roads. Work is now in progress on these highways. A bond issue of $10,000,000 has been proposed for the construction of a system of state highways. The state highway engineer, Mr. E. I. Cantine, accompanied by the state advisory board, has made a trip of inspection over a large part of the State and has found the sentiment everywhere favorable toward undertaking this work.

VALUE of the reports of the various technical bureaus of the Federal government has sometimes been diminished by delays in publication. While these delays may have been necessary to secure the complete accuracy required for a historical treatise, there have been times when approximately correct information published early enough to have more than a purely historical value, would have been welcome. That this need is now being recognized by the Department of the Interior is evidenced by the publication of a mid-year review prepared by the Geological Survey of business conditions in the mineral industries. Summaries of the reviews of the oil and cement industries appear elsewhere in our columns. While conditions in the oil industry are far from encouraging and the general tenor of the cement report is that the situation is not nearly so bad as was feared at one time, the metal producers are generally enjoying high prices and an immense demand for their products. These latter conditions are mainly due to war orders.

CONVENTIONS of engineers will be the order of the day in San Francisco during most of the month of September, as a perusal of the list of Coming Conventions, printed elsewhere, will show. Not the least important of these is the Pan-American Road Congress, which will meet in Oakland and San Francisco, September 13 to 18. For the past few years, the American Highway Association and the American Road-Builders' Association have held their annual conventions separately. This year both conventions are to be combined in what will probable be the largest gathering of road-experts that has even been convened. In addition, the Tri-State Good Roads Association, which has a large membership in California, Oregon, and Washington, has postponed its meeting from August 2 to September 13 in order to meet with the national associations. Road-building is easily the most important branch of engineering construction on the Pacific coast today and much valuable data concerning methods and costs will be presented at the coming sessions.

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IN California, highway maintenance as well as highway construction usually has been under the direction of the local supervisors. This arrangement was fairly satisfactory in the days when the first teamster laid out a road and the others followed in his wheel-tracks, but it is a source of much dissatisfaction, now that highway engineering has become a science. San Joaquin county was among the first in California to construct a system of permanent highways. When the system has been completed, the highway commission, recognizing the advantage of a centralized and scientific system of maintenance, turned the upkeep of the roads over to the county surveyor, Mr. F. E. Quail. The roads are patrolled daily and small defects repaired before they become serious. In addition, a gang is employed continually on larger repairs, using equipment owned by the county. So satisfactory has this system proved that it is probable that the maintenance of all county roads shortly will be turned over to the county surveyor. It will be remembered that a bill establishing a similar system throughout the State was defeated at the last session of the legislature, largely through the opposition of some of the less progressive county supervisors. It is to be hoped that some of the other counties of the State may adopt the centralized system of maintenance. Should this be done with the accompaniment of satisfactory results, the next legislature could hardly fail to establish a state system of centralized control of both construction and maintenance.

"WHAT is a public utility?" is a question that is now being discussed before the California Railroad Commission. Some time ago the Commission claimed jurisdiction over the California Development Company, which supplies water to Imperial valley, but the State Supreme Court decided that the company was not a public-service corporation, but a co-operative concern supplying only its own stockholders. Recently the rates of the Crocker-Huffman Land & Water Company of Merced, have been up for scrutiny and the company contends that it is not a public utility because it supplies water only under contract with consumers, these contracts being made a part of deeds for the sale of the land marketed by the company. The company has announced its intention to carry the case to the State Supreme Court if the present hearing goes against it. Should the company be sustained in its contention, a number of similar concerns throughout the State once more will be able to do business according to their own sweet will. It may also be affirmed that the lesson will not be lost upon the promoters of new companies.

ANOTHER interesting legal question which is now agitating a large part of the population of San Francisco is "When is an injunction not an injunction?" For several months the United Railroads has been gazing with longing eyes at the profits accruing to the Municipal Railroad from the operation of a direct line from the Ferry to the Exposition by way of Geary street. An ordinance permitting the United Railroads to run some of its Sutter Street cars direct to the Exposition was vetoed by the Mayor, and reprisals by the company were then in order. They came in the form of an application for an injunction to restrict the use of the Market street tracks to those municipal lines that were in existence when the original agreement for the use of these tracks was made. This would prevent the cars running to the Exposition from going through to the Ferry. To the dismay of the city authorities, the injunction was granted. As there was no possibility of obtaining a decision from the State Supreme Court before the close of the Exposition-period, heroic measures on the part of the city legal department were necessary. These measures took the form of an application for a stay of the injunction pending an appeal to the higher court. This stay was granted and the question of the rights of the United Railroads and the Municipal Railroad to the tracks on lower Market street is still to be decided. Meanwhile the cars of the municipal lines continue running to the Ferry.

SAN FRANCISCO'S water-supply problem is still in the discussion stage. What appeared to be the most feasible plan yet offered for financing the Hetch Hetchy development in the form of an offer to underwrite the entire issue by a banking syndicate, headed by Mr. Rudolph Spreckels, of San Francisco, has been definitely turned down by the city officials. The low rate of interest carried by these bonds and which was deemed sufficient at the time the issue was authorized, is no longer attractive to American bankers, and it would appear that at least for the present there will be small chance for disposing of these bonds in sufficient quantity to guarantee continuity of operations after construction work has once been started. The next move on the checkerboard of municipal politics is awaited with interest, especially by those living in the outlying districts of San Francisco, who are facing a serious lack of water supply. In the meantime, the Spring Valley Water Company, the purchase of whose property recently having been turned down by the voters of San Francisco, has been in almost continuous litigation with the city for many years over the constantly recurring dispute as to water rates. Money collected by the company at rates higher than those authorized by the city has been impounded pending legal adjudication of the difficulty. While this pleasant state of affairs was going on, the company, naturally feeling somewhat insecure in incurring fresh obligations for extensions, has indulged in the poker player's privilege of 'standing pat.' The company, if permitted to let the higher water rate stand, has offered to divert the funds acquired in this way for the purpose of extending its mains to those districts now suffering from a shortage of water and to increase the amount supplied to the city by about 25 per cent. This proposal the San Francisco board of supervisors has decided to accept. The chances therefore for the commencement of work on the Hetch Hetchy project seem remote, at least for the immediate present.

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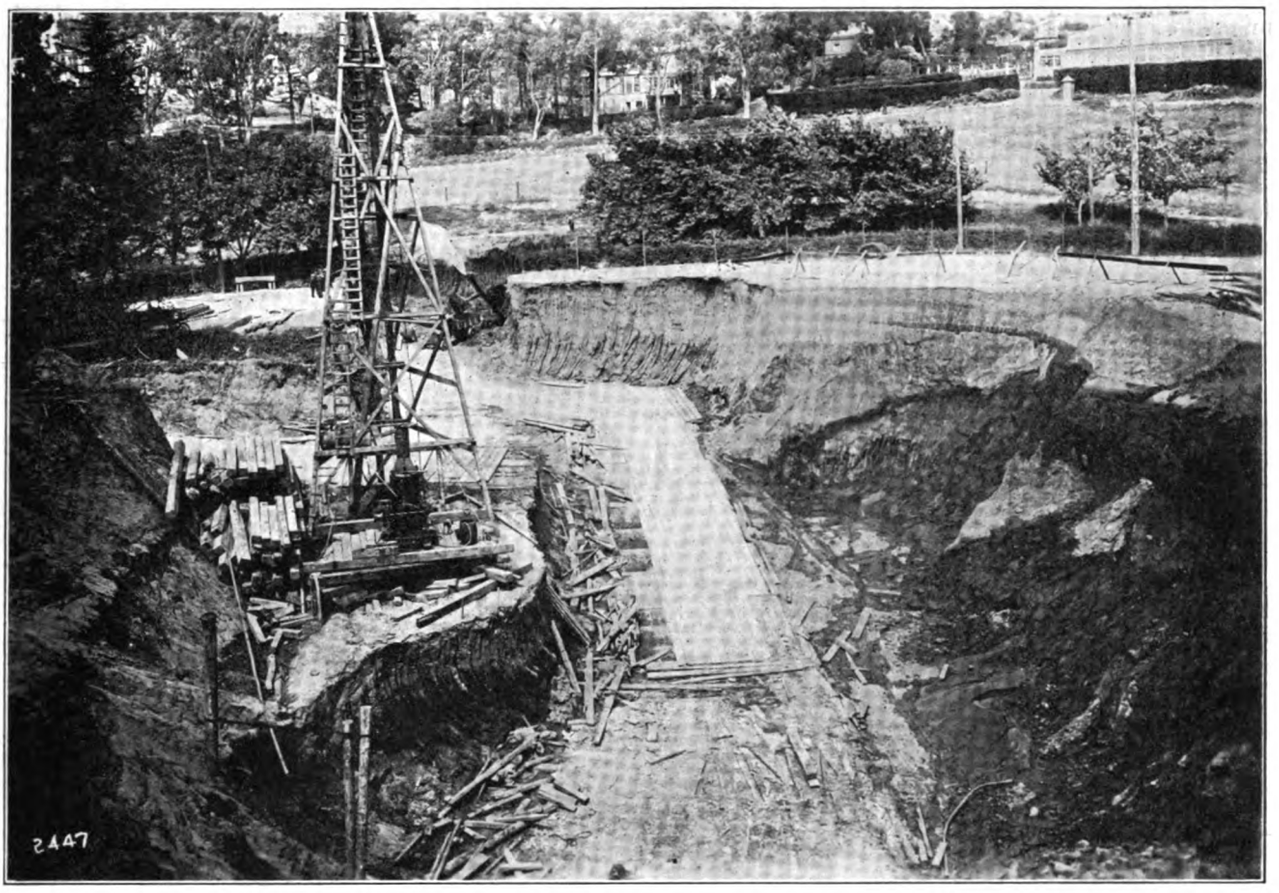

LAGUNA HONDA STATION, LOOKING EAST.

Methods of Construction on the Twin Peaks Tunnel*

The most important single recommendation made by Bion J. Arnold in his report of March 1913, was the construction of the Twin Peaks tunnel. The range of hills, of which the Twin Peaks are a part, forms an almost complete barrier between the business portion of San Francisco and a large area in the southwest part of the city. The construction of the tunnel will bring this area within about 25 minutes of the centre of the city. The general scope of the project is described in the October 1914 issue of WESTERN ENGINEERING. The contract for the entire work was awarded to R. C. Storrie & Company, of San Francisco, for the sum of $3,372,000, and work was commenced November 30, 1914.

The general plan and profile of the tunnel are shown in Fig. 1. The entire length of the project is about 12,800 ft., of which 9500 ft. will be in the tunnel proper, and the remainder 'cut-and-cover' work at the two portals. The standard or flat-topped section for 'cut-and-cover' work is shown in Fig. 2. This requires an average of 36 cu. yd. of excavation, 7 cu. yd. concrete, and 910 lb. of reinforcing-steel per lin. ft. of tunnel. The standard tunnel-section in earth is shown in Fig. 3, and requires 30 cu. yd. excavation, 8 cu. yd. concrete, and 480 lb. steel per lineal foot. The sections for soft rock and hard rock are similar to that for earth, except that the invert is nearly level and is unlined and the concrete arch is lighter. The soft-rock section requires 23 cu. yd. excavation, 5.5 cu. yd. concrete, and 480 lb. steel, and the hard-rock section, 19 cu. yd. excavation, 2.25 cu. yd. concrete, and 140 lb. of steel per lin. ft. of tunnel.

The work is being carried on at the present time from four points. At the easterly portal, the excavation has been made for about 2000 lin. ft. of 'cut-and-cover' section. The tunnel-portal is at the end of Market street, near 17th and Castro streets. There is a down-grade for a short distance to the Eureka Valley station, which will be the station at this end of the tunnel when future connections with a subway along Market street are made. The main structural work on this station has been completed. The station below the ground-surface has been so designed that it will be easy later on to connect the entire system with the future subway on Market street. Beyond the Eureka Valley station the excavation has been continued nearly to the point where the tunnel proper is to begin. A 1¼-yd. Marion shovel is being used for the excavation, loading direct into automobile trucks.

*From data furnished by M. M. O'Shaughnessy, city engineer of San Francisco.

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Part of the material is being used to backfill over the completed section and the remainder is dumped at various places in the city. Water-pipes have been 'dead-ended' and the consumers supplied from some other main. Sewers have been either 'dead-ended' or else carried across the excavation in temporary flumes. Some additional sewers and water-mains had to be laid.

The excavation so far has been in earth, which has, in general, stood up fairly well. Round piling has been driven along the sides of the excavation. From the portal as far as Eighteenth street, the streets crossed by the tunnel-line were not of sufficient importance to make it necessary to provide for the traffic during the comparatively short time until the backfill could be made. On Eighteenth street, however, there is a car-line and considerable other traffic, so that a temporary bridge-crossing has been erected. In order to give room for the steam-shovel to work, a minimum amount of bracing was used at first. A small slide resulted near this point, which did no damage, but the shovel was moved ahead, additional bracing was placed, and a pick-and-shovel gang put in to complete the work at this point. Near the present face of the excavation the tunnel-line crosses an old creek-bed, and a little water is now seeping into the bottom of the cut.

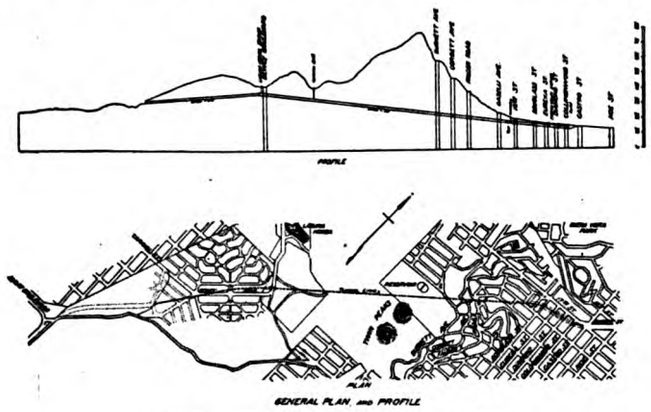

FIG. 1. GENERAL PLAN AND PROFILE.

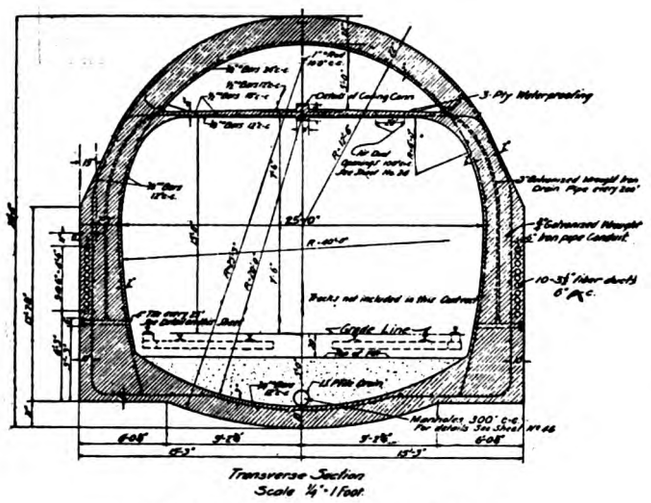

FIG. 2. TUNNEL SECTION FOR EARTH.

There will be a ventilating intake-station at Eighteenth and Hattie streets. At a point on the Relief Home tract, about a mile and a third from the easterly portal, a ventilating shaft 13 ft. in diameter is being sunk. This will be lined with concrete. At this point the grade of the floor of the tunnel is 100 ft. below the surface of the ground.

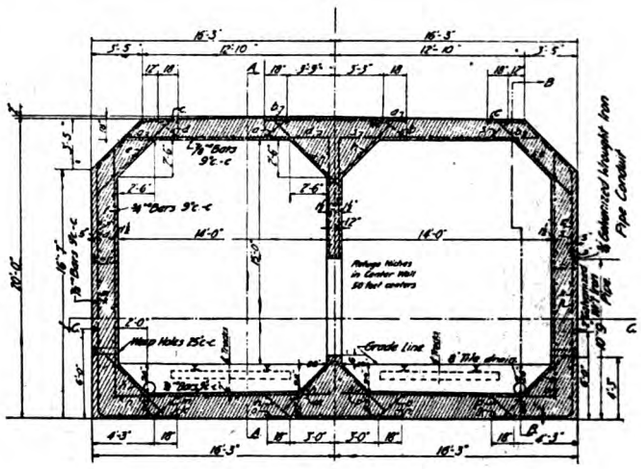

FIG. 3. FLAT-TOPPED SECTION.

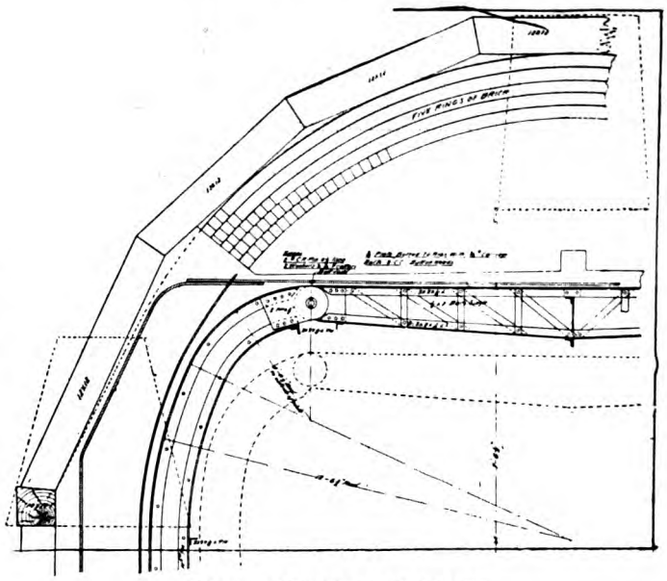

FIG. 4. SKETCH OF TIMBERING.

The site of the Laguna Honda station is about 8500 ft. from the easterly portal. The tunnel-grade is approximately 65 ft. above the ground-surface at this point. The district to be served by the tunnel extends from here toward the Ocean. The site of the station is in a narrow valley, and the material taken from the excavation for the station is being used to fill a part of this valley. The station when completed will be reached by stairways and elevators from the ground-surface 65 ft. above. The excavation for the station is practically complete and a steam-shovel is working easterly from that point. As the ground rises rapidly on this side the amount of 'cut-and-cover' excavation will be comparatively small. The material is earth and stands up fairly well.

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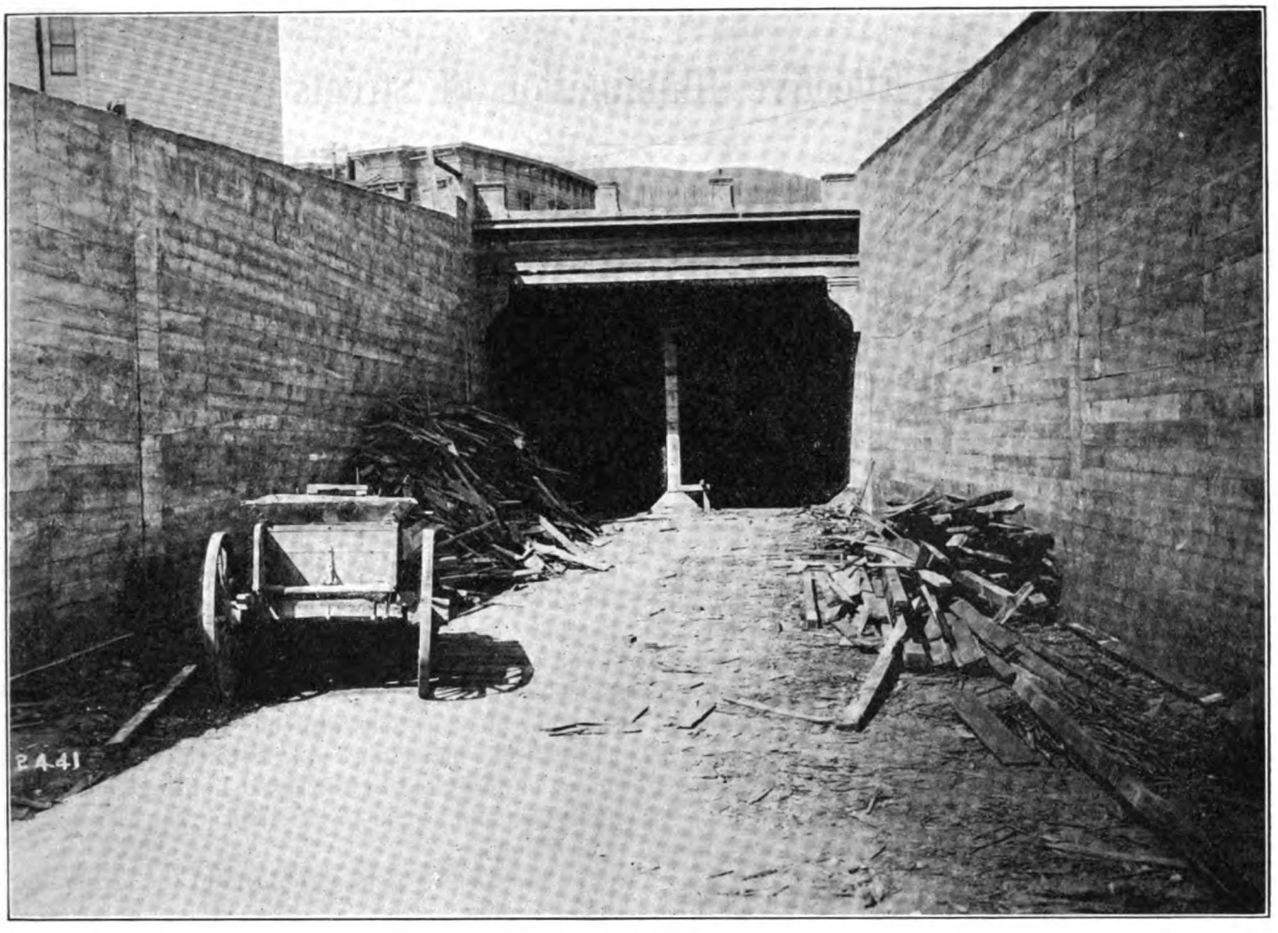

EASTERLY PORTAL.

On the westerly side of the station, the material is sand for a considerable distance below the ground-surface. This sand carries some water, and although piling has been driven and a pump placed in the excavation, some difficulty is being experienced from slides.

At the westerly portal, the approach or 'cut-and-cover' work was about 500 ft. long. This has been completed and work on the tunnel itself is in progress. The material is earth and requires heavy timbering. Three drifts 4 by 6 ft. are driven, two at the side for the wall-plates and one in the centre at the top of the arch. The wall-plates are then set, and the drifts enlarged sufficiently to set the arch-timbers. A seven-segment arch is used. The posts are then set and the remainder of the excavation made. The arch-segments and the posts are 12 by 12-in. timbers set solid. The wall-plates are 14 by 14 in. and the sills 6 by 14 inches. The general method of timbering is shown in Fig. 4 and also a special steel form for the concrete lining.

The concrete for the work is a $1:2\frac{1}{4}:5\frac{1}{2}$ mixture. Santa Cruz portland cement is used, with the addition of 8 lb. of Pyramid hydrated lime to every 100 lb. of cement.

The work was designed and is being done under the general supervision of M. M. O'Shaughnessy, city engineer of San Francisco, with L. T. McAfee, assistant engineer, in direct charge of the construction work.

SPEAKERS AT THE PAN-AMERICAN ROAD CONGRESS

While the complete program for the Pan-American Road Congress, which meets in Oakland, September 13 to 18, has not yet been decided, the following well-known authorities have already accepted assignments on the program: G. P. Coleman, state highway commissioner of Virginia, 'Convict Labor for Highway Work'; William H. Connell, chief of bureau of highways and street-cleaning of Philadelphia, 'Dust-Suppression and Street-Cleaning'; George W. Cooley, state engineer of Minnesota, 'Road-Drainage and Foundations'; A. W. Dean, chief engineer, Massachusetts highway commission, 'Maintenance, Materials, and Methods'; A. B. Fletcher, state highway engineer of California, 'Organization and System in Highway Work'; W. S. Gearhart, state engineer of Kansas, 'Highway Bridges and Structures'; Nelson P. Lewis, chief engineer, board of estimate and apportionment of New York City, 'Highway Indebtedness: Its Limitation and Regulation'; L. W. Page, director, U. S. Office of Public Roads, 'The History and Future of Highway Improvement'; Frank F. Rogers, state highway commissioner of Michigan, 'Roadway Surfacings'; and L. S. Smith, University of Wisconsin, 'The Educational Field for Highway Departments.'

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The Effective Illumination of Streets*

By PRESTON S. MILLAR†

The last two years have witnessed increases of 25 to 50% in efficiencies of street illuminants, the Mazda C incandescent lamp and the magnetite arc lamp having progressed contemporaneously. At the present time in the magnetite lamp of medium and high power, in the Mazda C lamp of low, medium, and high power, and in the flame arc-lamp of high power there are available illuminants having efficiencies four or five times greater than those of various types of enclosed carbon arc-lamps which were the principal street illuminants in this country a few years ago. Some advance has been made also in the design of lamp equipment, notable among which are the prismatic refractor and a variety of light-density translucent glassware which combines fairly good diffusion with high transmission. These improvements in the materials of street-illumination combined with the increased sums which municipalities are appropriating make possible a general improvement in street-lighting.

For the purposes of this discussion the following classification of streets is adopted:

Class.	Description.
1*a*	Metropolitan thoroughfares of greatest distinction.
1*b*	Important city streets largely traveled at night.
2*a*	Business streets not largely traversed at night.
2*b*	City residential streets.
3*a*	Suburban residential streets.
3*b*	Suburban thoroughfares.

It will be apparent that requirements for street illumination are diverse as among these different classes of streets. For example, the 1*a* class of streets is distinguished by a requirement for dignified, pleasing fixtures and for lamps and illumination which should be of fairly high intensity, lighting building fronts as well as street. Streets of the 1*b* class are likely to be characterized by much show-window and sign lighting which augments the street illumination during the hours of greatest traffic. Here intensities are likely to be highest, and the ordinary fundamental requirements of street lighting are supplemented by the desirability for recognizing acquaintances in the passing throng and for detailed vision, approaching that common to interiors at night. In streets of the 2*a* class a moderate intensity of illumination which lights building-fronts as well as streets is customary. Policing purposes and good seeing-conditions for the occasional pedestrian are the principal desiderata. In streets of the 2*b* class it is usually desirable to keep the light upon the street surface, avoiding brilliant illumination of the upper stories of residences and providing fairly good lighting for the vehicular and pedestrian traffic. In streets of the 3*a* class it is likewise desirable to keep the light upon the street, illuminating the sidewalks well to serve the purposes of pedestrians. In streets of the 3*b* class, which are the important automobile highways connecting populous centres, the principal requirement is that of the automobile driver. Here the most difficult problems of street illumination are encountered. The discussion in this paper is applicable in varying degree to streets of these six classes.

The objects of street illumination may be stated in somewhat different ways. When, however, one assembles the considerations growing out of all viewpoints, those of first importance appear to fall within the classification presented by the street lighting committee of the National Electric Light Association in 1914 which is as follows:

1. Discernment of large objects in the street and on the sidewalks.
2. Discernment of surface irregularities in the street and on the sidewalks.
3. Good general appearance of the lighted street.

In proportion as these three purposes are served, the street illumination will be regarded as satisfactory, and it may be concluded that no street lighting installation that serves these three purposes can be regarded as unsatisfactory. The weight to be given each will vary in different streets though in a general way it is probable that the purposes are served in the order named.

In streets at night, objects are seen by reason of contour, relief, shadow, or color. We perceive the contour of objects when they are markedly different in brightness from their background. Since most large objects on the street at night are darker than their background, we perceive them usually as silhouettes. Contrasts in relief are perceived when the exposed surface of an adequately illuminated object presents areas of different reflecting powers, or elements which are more or less favorably inclined with respect to incident light, or elements which lie in the shadow of other elements of the surface. We may perceive small objects by reason of their shadows occasioned by the interception of sharply inclined rays of light. Shadows of large objects are not always of value in promoting discernment and are often misleading, as in case of the shadow of a telegraph-pole thrown across the sidewalk. Color contrasts are not usually relied upon, since where discernment is at all difficult, color is usually lost and objects are perceived more readily by other means.

*Abstract of paper presented at the annual convention of the American Institute of Electrical Engineers, June 1915.

†General manager, Electrical Testing Laboratories, 80th street and East End avenue, New York City.

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Contrast perception is the ruling visual process with which street illumination is concerned. To increase contrasts on surfaces to be seen is to better conditions for vision.

In much of the literature of street illumination, curves of illumination-intensity form the principal basis of judgment as to effectiveness. There is a tendency to over-emphasize the importance of incident light to the prejudice of other important considerations. Three of the principal considerations which are not emphasized directly by study of illumination-intensity curves are presented in the following paragraphs.

When the writer directed attention to the silhouette effect in 1910[1], there existed but little appreciation of its importance. During the five years which have intervened there has developed a greater appreciation of the extent to which it enters into conditions of visibility in street illumination. Yet its general applicability even now is unrecognized by some engineers. There is an impression that only in lighting of low intensity is it the prevailing method of discernment. As a matter of fact the silhouette effect is pronounced whenever there are bright street or building backgrounds. A photographic under-exposure of any street in the daytime shows objects as silhouettes. The casual glance of an automobile driver corresponds roughly with such an under-exposure. The majority of observations of large objects on the streets in our more intensely lighted thoroughfares, especially in the practice of automobile drivers, falls under this heading, because a driver is concerned primarily with avoiding obstacles and usually looks carefully enough only to detect the presence of pedestrians and other objects. Usually he sees these as dark objects silhouetted against the lighter street-surface or building-surfaces. The pedestrian too obtains distant views of large objects as silhouettes, but as he moves more slowly and approaches objects more closely, he has opportunity for closer observation, and in the more brightly lighted streets, supplements discernment by silhouette with actual observation of surfaces in relief.

Modern streets which require greatest care in lighting are traversed by automobiles. The majority of them are paved with asphalt, asphalt-block, wooden-block, treated-macadam, etc. As a result of automobile traffic such pavements become oiled and polished. The high spots of the pavement then reflect specularly.

Any street which is largely traversed by automobiles, and which has pavement of the types named above, is likely to appear rather dark because of the oil which is deposited upon it from automobiles. It is, however, a most favorable surface for street-lighting puposes because of its tendency to reflect specularly. It was found that Seventh avenue, New York City, has three to four times the effective brightness per lumen of incident light as another prominent thoroughfare which is paved with belgian-block. Fig. 2 which will be referred to in another connection, is an additional example of this effect as encountered in a country road paved with treated macadam. The roadway between lamps, from the driver's point of view, is well illuminated due in part to its specular character.

The effect of glare in street illumination is dependent primarily upon:

1. The extremes of contrast within view; that is, contrast in brightness between the light-source and the illuminated surfaces.
2. The visual angle separating the glaring source from the observed surfaces.
3. The portion of the field of view which is illuminated.

Glare militates against good street-illumination, first in decreasing ability to see, and second, in rendering unpleasant the appearance of the lighting-system and the street. Insofar as it reduces visual power it manifests itself in three ways:

1. Actual diminution in ability to perceive small contrasts in the presence of a bright light source.
2. Distraction of attention, as a result of which small contrasts may not be perceived when viewed casually.
3. A temporary dazzling effect which persists for a few moments after a bright light-source is viewed directly.

If a single brilliant light-source, as a bare Mazda C lamp is placed over an earth road in the country, the glare is objectionable. If the lamp is raised to a greater height or moved to one side of the road, or if the lamp is enclosed in a diffusing-globe, the glare is lessened. If a number of additional lamps are strung beyond it along the road, the glare is further reduced. If the lamps, instead of being placed over an earth road, are over a treated macadam road; or better still, over an asphalt road, the glare is less serious. Light-colored buildings along the street also assist reducing the glare. In short, anything which reduces the contrast between the light-source and the road surface, or which increases the illuminated area within view, or which separates the bright light-source from the road surface, reduces the effect of glare. Since the problem is really one of reducing contrast between the light-source and the illuminated surfaces, the more constructive way of accomplishing the desired end is to increase the brightness of the illuminated surfaces rather than to dim the light-sources unduly. Excessive brightness of light-sources must of course be reduced. It is common experience that a simple diffusing-globe accomplishes this under most conditions. Too great reduction in the brightness of the light-source is unsatisfactory psychologically. We like a bright light-source—we are dissatisfied with illumination in which a bright light-source is not visible. Therefore the thing to do is to eliminate glare by increasing the brightness of the street surface, and where desirable, that of surroundings, and by reducing the brightness of the light-sources moderately, throughout the angles at which they are viewed.

The effectiveness of street illumination depends upon the following:

[1] An Unrecognized Aspect of Street Illumination. Millar, Transactions I. E. S., 1910, page 546.

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1. Intensity of light upon the street. There is no single measure of intensity which serves all purposes. The average horizontal intensity upon the street surface is most nearly satisfactory.

2. Brightness of street surface. Adopting the automobilist's viewpoint as to angle and direction.

3. Relation between lamps and street surface. Visual angle between the two, and extremes of contrast encountered.

4. Contrasts produced on the street surface and on objects on the street. This is largely a function of the direction of the light.

5. Portion of total field of view illuminated. This may be affected either by the number of lighted lamps within view or by the area of surface which is illuminated.

6. Appearance of installation and of street by day and by night. Lamps, fixtures, light-distribution, etc.

There is now a general tendency toward the adoption of more powerful lamps of either the flame-arc, magnetite, or Mazda C type. Of the above illuminants the flame-arc lamp and the multiple Mazda C lamp depreciate in candlepower 20 to 25% during their life. The magnetite lamp and the series Mazda C lamps do not change materially throughout their life.

The cluster of lamps employed so largely in ornamental or 'white way' lighting during the past five years has yielded favor in most recent lighting-systems to the single illuminant or less frequently to twin illuminants on one post. The effectiveness of the light, other things being equal, is dependent upon the choice as between many small lighting-units and few large lighting-units. In favor of the small units, it is urged that greater uniformity results from their use; that they may be mounted lower, thus avoiding shadows from trees, etc.; and it is added that when small illuminants are mounted low, a larger proportion of their total flux is distributed over the street surface. On the other hand, it is argued in favor of large units that they are relatively less costly per mile, and that usually the appearance of a street lighted by them is more pleasing.

There are two considerations not usually urged in this connection. Large units are often favored because they may be placed well out over the middle of the street, where the specular reflection from street surfaces allows the light to be applied in a more favorable direction than that from small units, which usually are mounted low over the curb. Fig. 2 is an illustration of the advantageous use of large units in lighting a country road. The lamps are placed 500 to 900 ft. apart and 18 to 25 ft. above the road. The effect is good for automobile-driving purposes. An example of ineffective use of small units will occur to all who can visualize a wide, wet street with lamps over both curbs. The lighting of the street surface consists of a few bright streaks near the curbs, while the middle of the street is dark. As modern street pavements are extended, and automobile traffic increases, the advantages of mounting lamps well over the center of the street tend to increase, and the disadvantages of small units mounted low over the curbs tend to become more apparent. The second consideration was brought out prominently last year by the street lighting committees of the National Electric Light Association and of the Association of Edison Illuminating Companies. It was shown that within reasonable limits, uni-directional light is to be preferred to multi-directional light because it enhances contrasts upon which discernment is dependent. Objects and surface irregularities are seen more surely by uni-directional light than by light coming from a number of directions. From this it follows that, other things being equal, the revealing power of a few large units is greater than that of many small units, especially if the latter are staggered along both curbs. While these considerations do not indicate clearly the desirability of large units, they do add weight to the arguments in their favor.

The most desirable distribution of light depends largely on the nature of the street surface and on the character of the street. Hence there is no such thing as a correct distribution characteristic for all street-lighting. The prismatic refractor is successful in providing a distribution-characteristic, that, for a vertical plane, conforms to the theoretical requirements as laid down by some engineers. In other forms it will doubtless provide different distributions as required. It is an admirable device so far as re-direction of light is concerned. However, it is objectionable in some forms because of excessive brightness, due to its small size. Also when combined with the casings with which it is usually employed, its appearance is not attractive. Probably in the evolution of this useful device these objections will be overcome.

The employment of diffusing-globes to decrease brightness of light-sources in the street has become more general in recent years. Perhaps the extreme example in the way of increased size of such globes is found in the lighting-system at Washington, D. C., where ornamental magnetite lamps are used with 28-in. built-up alabaster globes of rather high density. As compared with the use of a clear globe or of a lamp with no globe, a diffusing-globe of fairly large size is usually desirable because it improves the appearance of the lighting-unit, renders the appearance of the street more pleasing and promotes good conditions of visibility. Because of neglect of simple and inexpensive tests of commercially available glassware, globes are often used which do not accomplish the purposes in view so well as would other glassware. These either absorb a larger proportion of light than is necessary to secure the desired degree of diffusion, or else do not diffuse as well as need be, considering the amount of absorption.

As between centre and curb positions for lighting-units there is a considerable difference. In the first place with lamps located over each curb, the street appears much wider. In the lighting of important city streets this is usually a desirable condition. The lamps mounted over the curbs likewise illuminate the sidewalks and the fronts of buildings better. When, however, the lighting of the roadway becomes of first importance, as in streets of the 3*b* class, the best use may be made of the light by placing the lamps as nearly as practicable over the roadway so

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as to take full advantage of specular reflection from the street surface.

In regard to heights of lamps there is also a wide difference in requirements, depending upon the character of the street. In some of the latest practice, powerful lamps are located 14 to 18 ft. over the curbs on business streets. These, however, are backed by light-colored buildings and the entire surrounding is so brightly lighted that the glare is not objectionable. With lamps over the middle of the street the background is usually the dark sky, and generally there are not light-colored buildings to relieve the general darkness. Under these conditions the opportunity for glare to become serious is considerable and it is therefore necessary to place the lamps rather high. The improvement realized in increasing the height of lamps of moderate power from 18 to 20 ft. is considerable, while the improvement in increasing the height from say 27 to 30 ft. is not so great. Around a lamp which has a dark background there is a zone of halation within which objects tend to become invisible. Once outside this zone, the glare effect falls off less rapidly. It is important to mount the lamps high enough to insure that the separation from the street surface is at least sufficient to avoid this zone of serious glare.

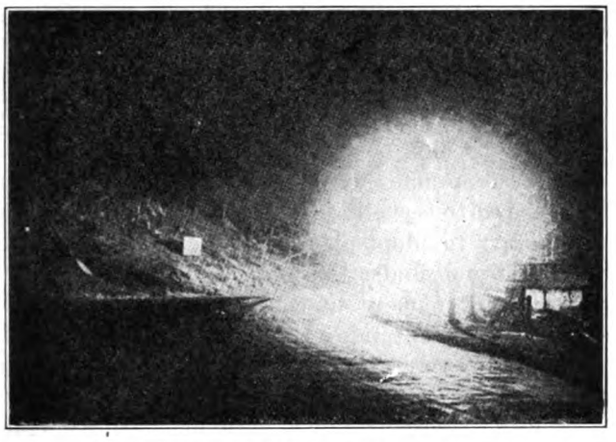

FIG. 1. COUNTRY ROAD, INCORRECTLY LIGHTED.

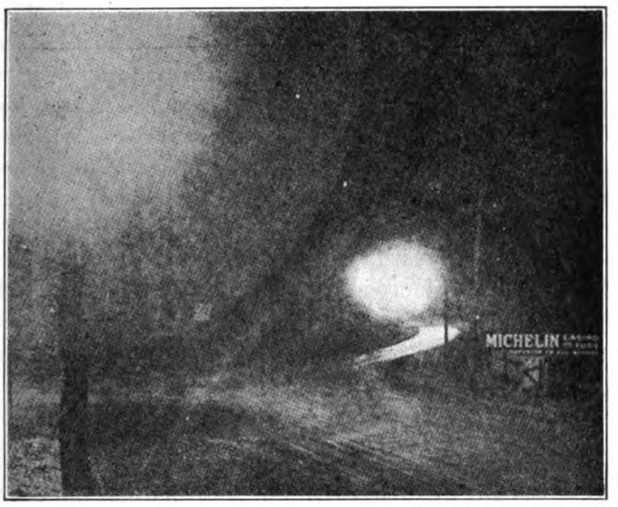

FIG. 2. COUNTRY ROAD, CORRECTLY LIGHTED.

Other things being equal, the objectionable effects of glare are greater when the lighting-units are more powerful. Hence it is approved practice to mount the more powerful units higher than less powerful units. Such a lack of separation is responsible for the serious glare illustrated in Fig. 1. An arc-lamp is placed over the inside of a curve in a road obscuring the roadway beyond. The angle of separation between lamp and roadway is about three degrees. Fig. 2 shows the same roadway but with a lamp placed over the outside of the curve and separated from the distant roadway by about 20 degrees when viewed as in driving. It must be recognized that a bright light-source obscures its immediate background. This obscuration is greater if the light-source is brighter or more powerful, and is less if the background is brighter. With country-road or park-drive lighting, such obscuration is often serious. The illustrations in Fig. 1 and 2 show one good way of overcoming this difficulty. Recognizing that under such conditions the bright light-sources will obscure a certain region of the field of view, the source is so placed that the background which it obscures is one which it is not important to see and that the surface which it is desired to see is sufficiently separated from the glaring light-source to avoid difficulty.

All parts of a lighting-system should be treated in such a way as to avoid dark areas between lamps, coupled with low mountings for bright and powerful lamps. To avoid ineffective results due to multi-directional light which reduces contrasts, spacings need to be greater when the lamps are staggered along both curbs than when they form a line along one side or over the middle of the street. The best spacing would appear to be contingent upon the kind of pavement employed and the nature of the surroundings. All the other factors should be so handled that in driving, one will not encounter the bad condition of a bright light-source preventing an adequate view of the surface of the street beyond it.

As more money is expended on street-lighting and as more efficient lamps are made available, the intensities of light in streets become greater. As the intensities increase, the requirements for the best possible application of light to promote good visibility-conditions become less severe and the requirements for application which improve the appearance of the street become more urgent. From the standpoint of rendering visible the street and objects upon it, the lighting of suburban automobile roads where but little money is available for installation and operation offers the best test for the engineer's skill. In first-class streets we have already progressed to the point where aesthetics assume importance. This does not mean, however, that the problems of street-lighting are becoming less difficult; it means simply that the problems are becoming more involved, and broader comprehension of the fundamental principles of street-illumination is becoming more essential.

A new wall map of Alaska, 82 by 55 in., may be purchased from the Geological Survey, Washington, D. C., at 80c. per copy. It shows the survey of the new Government railway from Seward to Fairbanks.

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The Amador Irrigation Project*

An irrigation project of considerable potential importance to central California is now under consideration in Amador and Sacramento counties. It is intended to obtain water from several small streams in Amador county, and eventually perhaps from the Mokelumne river. The project is yet in a formative stage, but steps are being taken for the formation of an irrigation district. While no detailed surveys have been undertaken, a preliminary investigation has been made by J. T. Whittlesey, from whose report the following information has been taken.

The land to be irrigated includes 12,000 acres in a foothill valley near Ione, in Amador county, 23,000 acres between the 50 and the 100-ft. contours near Galt, in Sacramento county, and ultimately 25,000 acres additional in San Joaquin county east of Lodi. The most important feature of the entire project is a natural reservoir-site at the old mining town of Volcano. From a reconnaissance it is estimated that a 75-ft. dam would impound 19,000 acre-feet of water, a 150-ft. dam, 52,000 acre-feet, and a 200-ft. dam 100,000 acre-feet. The cost after allowing for purchase of land and mining rights, as well as the actual construction would range from $14 per acre-foot for the 75-ft. dam down to $8.50 per acre-foot for the 200-ft. dam. Water-rights now owned by the Consolidated Amador, Volcano Hydraulic Gold Mining Company will have to be acquired.

In the construction of the distribution system use can be made of the channel of Sutter creek, from Volcano to Ione. For the main ditches, a concrete lining 3 in. thick is recommended, and steel flumes where ditches are not practicable.

Two alternative plans are suggested for the carrying out of the project, each providing for progressive development. In plan A, it is proposed as a first step to utilize the runoff of the watershed tributary to the Volcano reservoir, whose area is 31 square miles. This can be done by the construction of a dam 125 ft. high, providing 38,000 acre-feet of storage. This would allow a safe draft of 40,000 acre-feet per year. The average annual rainfall in the area to be irrigated is approximately 20 inches. It is believed that 24 in. additional will be sufficient for all crops. Assuming a loss in transmission of 25% and that 85% of the land in the district will be irrigated, this would provide water for 19,000 acres. If it is desired at the present time to store only part of the runoff from the Volcano watershed, it would be advisable to build a dam but 75 ft. high which would store water enough to irrigate 10,000 acres at Ione. This would cost $450,000 or $45 per acre.

To increase the supply still further, an adjacent watershed with an area of 40 square miles, could be made available by the construction of a ditch, flume, and some short tunnels. This would bring the safe draft up to 72,000 acres, the irrigated area to 29,000 acres, and the area of the district to 34,000 acres. The cost would be $1,430,000 or $48 per irrigated acre. This would be the maximum development possible under plan A, and would be sufficient to irrigate the foothill-area near Ione and the plains-area near Galt. Should it be desired to serve the land near Lodi also, it would be necessary to adopt plan B.

The first step under this plan would be the same as with plan A, namely to construct a 125-ft. dam to serve a district containing 19,000 acres. To increase the amount of water available under this plan, it is proposed to drive a tunnel from the Mokelumne river to the Volcano reservoir. Such a tunnel would be about five and a half miles long. If constructed 8 ft. in diameter, it could supply enough water for a safe draft of 130,000 acre-feet per year, or enough to irrigate 52,000 acres, or a district of 61,000 acres. The estimated cost of this plan is $3,350,000 or about $64.50 per irrigated acre. The high cost per acre of this latter plan makes it doubtful whether or not it can be carried out in full. In all probability plan A will be adopted with the idea of constructing the tunnel from the Mokelumne river at some future time when the value of water for irrigation shall justify the cost. One great advantage of the entire project is the opportunity offered to fit the amount of work done to the money available and to add to the project from time to time without sacrificing any of the earlier work.

*From data furnished by J. T. Whittlesey, Claus Spreckles Bdg., San Francisco, California.

Operation of cars with the Edison storage-battery was recently demonstrated on the main line of the Pennsylvania railroad from Newark to Holmesburg Junction. The demonstration car made the 69-mile trip between Newark and Holmesburg Junction successfully in 2 hours 32 minutes actual running time, not including stops made at Trenton and Bristol for the purpose of letting passengers off. The average running speed of the car was 27 miles per hour, with forty-four passengers. This car will be operated experimentally for one month on the 3.8-mile Holmesburg Junction-Bustleton branch of the Pennsylvania railroad, after which two new storage-battery cars will probably be operated on the regular passenger service of the branch. At the end of about six months, if the battery proves reliable and shows a saving in car-mile costs, it is likely that from 50 to 75 storage-battery cars will be adopted by the Pennsylvania railroad for general branch-line service. A considerable saving over steam-operation is expected where the traffic is light.—*Mechanical World.*

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EXCAVATING FOR THE DAM.

THE DAM ITSELF.

A Novel Debris-Dam

By LEROY A. PALMER

Gold was accidentally discovered in California in 1848. In 1849 fully 100,000 miners were washing the gravel in the streams and gulches of the Sierras. The pan was shortly followed by the rocker, brought from Georgia, then came the 'long tom' and the 'sluice-box.' With the sluices came the demand for some means of moving the gravel in larger quantities than before and an ingenious Yankee conceived the idea of directing a stream of water against the bank, using a rawhide hose with a cow's horn for a nozzle. This method was so effective that it was generally adopted and the crude apparatus soon developed into the steel penstock and the hydraulic giant of a later day.

The progress of hydraulic mining brought forth a problem that resulted in much bitter feeling and long continued litigation between the different interests involved. The first comers were essentially miners and sought gold regardless of the consequences that might attend their search. But the agricultural possibilities of the country were too great to be long overlooked, therefore many of the newcomers turned to this industry and much land was put to the raising of crops, the valleys watered by the largest rivers, the Sacramento and the San Joaquin, being the first and most thickly settled.

These streams flow with gentle grades through wide valleys covered with the flood-plain deposits of earlier periods. Consequently the spring freshets result in floods that spread over a considerable territory unless controlled by levees. Calculations have been made of the rate of erosion of various rivers. Using the figures of the Po, in Italy, where conditions approach most nearly those of the Sacramento, it has been estimated that the sediment carried by the latter which is derived from the natural erosion of its own channel and its tributaries varies from 5,600,000 to 43,000,000 cu. yd. per year. The problem was serious enough in itself without adding to this amount the vast quantities of debris resulting from the placer operations, which in many cases had grown to enormous size and had involved large amounts of money in permanent works.

The accompanying photograph shows part of the pit of the Malakoff mine at North Bloomfield, in Nevada county, the largest placer mine of all time and one from which some of the most valuable data on hydraulic mining have been obtained. One can get some idea of the debris of this one mine by realizing that its banks reached a maximum height of 265 ft., water was used under a head of 800 ft., a static pressure of 347.2 lb. per square inch, and directed against the banks through nozzles with diameters up to 8 inches. In 1877 the Malakoff used 595,000 miner's 24-hour inches and moved 2,993,930 cu. yd. of gravel. From 1870 to 1877 inclusive it moved 11,021,630 cu. yd. of gravel.

Various figures have been given as to the duty of water in hydraulic mining, all of which vary widely, the chief factors being the character of the material and the size and grade of the sluices. At the Malakoff it varied from 18 to 21 cu. yd. of water for each yard of gravel. Harts* places the average duty at the mines on the Sacramento watershed at three cubic yards per miner's 24-hour inch, equal to 26.66 cu. yd. water per yard of gravel moved. These figures are quoted to give some idea of the immense amounts of debris washed from the watersheds of the rivers mentioned. It must be remembered that when hydraulic mining was in its prime practically the entire flow of the mountain streams was put to this use.

The State Engineer of California estimated that in 1880 53,400,000 cu. yd. of sediment and gravel found its way into the Sacramento basin. 18,100,000 cu. yd., of which 4,900,000 cu. yd. was the result of natural erosion,

*For most of the data concerning erosion and the debris deposited I am indebted to 'Control of Hydraulic Mining in California by the Federal Government' by W. W. Harts, Trans. Am. Soc. C. E., Vol. 57.

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was brought down in suspension; of this 2,100,000 cu. yd. settled in the overflowed basins and 16,000,000 cu. yd. was deposited along the channel or carried into the bays of Suisun and San Francisco. From 1849 to 1880 the low-water plane of the Sacramento was raised 7½ ft., tides at the city of Sacramento almost disappeared, navigation was seriously impeded, and it was estimated that this stream contained 108,000,000 cu. yd. of placer debris.

Conditions on the San Joaquin river were similar, but it is probable that the Yuba, to which the largest operations including the Malakoff, were tributary, was the greatest sufferer. It was estimated that the Lower Yuba contained 333,000,000 cu. yd. of debris and the low-water plane at Marysville was raised 15 ft., making necessary the construction of an extensive system of levees to protect adjacent lands from inundation.

Obviously such a condition was intolerable to the agriculturists, whose lands were frequently overflowed and covered with fine tailing, and to those who had invested money in river-transportation enterprises. Various legal actions were started. After some years of litigation the year 1880 found hydraulic mining on the watersheds of the Sacramento and San Joaquin rivers practically stopped by injunctions obtained in the local and Federal courts.

At this point the matter was made the subject of investigation by Congress, and this investigation was carried on for eight years, from 1880 to 1888, finally resulting in 1893 in the passage of the Caminetti Act. This Act was ostensibly designed to protect the navigable rivers, but its provisions were such that it also has the effect of protecting the agricultural lands, as only those mines were allowed to operate that could do so without discharging their debris into the navigable streams. At first thought this might appear to be an assumption by Congress of authority over State affairs, for the trouble was confined to two river-basins in the state of California, but it is based on the constitutional authority of Congress to exercise jurisdiction over navigable rivers and interstate commerce. The validity of the Act has not been questioned; in fact, the miners welcomed any move that might permit even a few of them to operate.

The Act created the California Debris Commission, a Federal board of three members from the Engineer Corps of the U. S. Army, with authority to pass on all schemes for the impounding or controlling of debris from hydraulic mining operations with power to stop any that do not meet with its approval. Thus the effect of the Act is to permit such mines to operate as will install works adequate to control their tailing and prevent it from reaching the navigable streams of the valleys. The authority of the Commission is limited to the watersheds of the Sacramento and San Joaquin rivers, and its duties also include investigations and formulation of plans to improve the navigability of these streams in their lower reaches.

The Commission has worked with a broad-minded spirit, the result being that many hydraulic mines have been able to resume operations, while there has been a gradual improvement in the condition of the lower river-channels. The choice of a dam is wholly within the discretion of the operator, the only conditions being that it shall be efficient and safe. Many types have been used, notably stone, earth, brush and rock, and log cribbed with rock-filling. Some concrete dams have been built but in general they are too expensive for this purpose, so that the log cribbed with rock-fill is probably the most common. A debris dam, however, must combine efficiency and safety with economy. Most hydraulic mining is conducted on a narrow margin of profit and it has been found too often that the dam designed to meet the requirements of the Debris Commission added so much to the expense of operations as to make it unprofitable. For this reason the dam now under construction to impound the tailing of the Omega mine in Nevada county is of interest, as it has met the requirements of the Commission and has been constructed at a very small expense per yard of gravel hydraulicked.

The Omega hydraulic mine is situated on the channel of the Tertiary Yuba river about 3½ miles above Washington, California, an old settlement dating back to the very earliest days of the great stampede. It is perhaps fitting that the dam to be described, the first of its kind, should be built within a short distance of the spot where the clever Yankee first turned his water through the rawhide hose with its cow's horn nozzle.

The tailing from the Omega mine discharges into Scotchman creek. The first dam was built about 2½ miles below the mine and about a quarter of a mile above the South Fork of the Yuba river at a point where the creek cuts a narrow channel through the slate that forms a part of the Blue Canyon member of the Calaveras formation. This dam is made of concrete, 23 ft. long at the bottom, 55 ft. long at the top, 15 ft. thick on top with a down-stream face 45 ft. high. The reservoir formed thereby was of small capacity, so that it was soon filled, and as the length increased rapidly with the height the economic limit of such a dam was soon reached.

After a period of idleness the mine resumed operations and construction was commenced of what, for lack of a better name, may be called a 'basket' dam. The old concrete dam was used for the toe of the new dam and the tailing back of it was excavated to a depth of two feet. In the excavation, two tiers of baskets were laid butting against the old dam. The basket dam was designed by J. M. Howells, of San Francisco, who conceived the idea from the Japanese *jakago*, a levee facing of loose rock restrained by bamboos so constructed that if the facing is undermined by the current the rocks settle of themselves and cover the eroded spot.

Construction of the basket dam proceeded as follows: The baskets were made of ordinary poultry-netting of 14-gauge galvanized wire and 6-ft. widths. For a reason to be mentioned later the length of the baskets varies, eight feet being the average at the time these notes were made. Such a basket is made by cutting eight feet of poultry-netting and folding it over so as to bring the two bound

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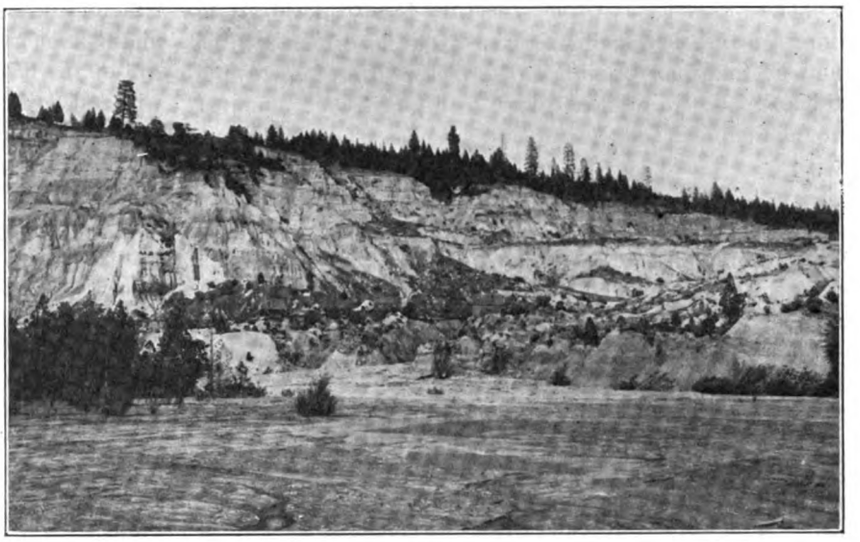
edges together on top and then wiring the meshes of the netting together on the ends. This can perhaps best be understood by folding a piece of paper as described. The result is a wire container that may be described as pillow-shaped with a seam opening lengthwise along the top and of such dimensions that when filled it will measure 8 by 2 by 1 feet.

In building the dam a two-inch plank is set on edge two feet from the bank, or from the last basket laid, and held in place by driving iron pins alongside. One of the empty baskets is set in the two-foot space thus formed and filled with small boulders, not larger than a man's head, with sand and gravel sprinkled into the interstices. The open edges of the netting are then brought together by means of a curved piece of strap-iron with a sharply curved hook on the end and held while they are tied together with wire. The down-stream ends of the baskets are lined to a wire stretched taut along the line to which they are to be built and the tops are brought to level with a straight-edge. A spillway 20 ft. long and 1 ft. deep is carried at one end of the dam. Each row of baskets is started with its down-stream face one-half its length back from the corresponding face of the basket on which it rests. Thus if 8-ft. baskets are used they will lap 4 ft. As the baskets are laid, gravel is filled behind them for 10 ft. so that the top width of the dam is 10 ft. *plus* the length of the basket, or an average at the Omega dam of 18 feet. The concrete dam was built at a point where the creek makes a sharp bend almost at a right angle, so that in carrying this dam up it has been necessary to curve it to conform with this bend, which gives it the fan shape shown in the photograph. On this account the length of the baskets has been varied, causing a corresponding variation of the slope of the down-stream face. At the time these notes were made the dam was 150 ft. long, including the spillway, and 35 ft. high, with a slope on the inner side of 2 : 1 and on the outer side of 6 : 1. The cross-section illustrates the average as it is at present, a 4 :1 slope using 8-ft. baskets. When the dam reaches a point on the stream where it is no longer necessary to carry the fan shape, 6-ft. baskets will be used with a lap of four feet giving a down-stream slope of two to one.

Conditions prevailing at the Omega site were not favorable to the lowest cost of operation. The ideal condition would be one that would allow of backfilling with a hydraulic giant, but this was not possible. Dragline excavators were tried, but it was found that under present conditions they are not feasible. They can be operated in another season. It was therefore found necessary to excavate with pick and shovel and move the dirt by wheeling. Fortunately there is plenty of gravel at each end of the dam, so that even with this method the cost is not excessive.

When the mine is discharging 1000 cu. yd. of tailing per day, the debris can be controlled by 2 men laying baskets and 4 men shoveling and wheeling. If wages are $3 per day, with a foreman at $4, this would bring the labor cost to $22 per day. This is the only expense except for poultry-netting and wear of the tools, which amounts to not over $5 per day, so that under present conditions the total cost is approximately 2.7c. per yard of gravel hydraulicked. However, as the height of the dam is increased the area of the pond increases rapidly in both length and breadth out of proportion to the increase necessary in the length of the dam as it is raised. For this reason it is expected that in another season the same amount of work and material now necessary to control 1000 cu. yd. of tailing will then impound approximately 4000 cu. yd., thus bringing the cost per yard of gravel hydraulicked to about 0.7 cent.



THE MALAKOFF GOLD-GRAVEL MINE.

The above crew can lay and back-fill 20 baskets per day. One basket (average at present) is 8 by 2 by 1 ft., so that the basket-work amounts to 320 cu. ft. per day. Back of the basket-work is 10 ft. of back-fill, 6 ft. of which is on the earth already filled in and thus only one foot deep while four feet must go down to the bottom of the pond, about 6 ft. on a 1½ :1 slope, making a total for the 40 ft. of dam laid in a day of 1520 cu. ft. or 56.3 cu. yd. at a cost of 48c. per yard.

One of the regulations of the Debris Commission provides that the water in the pond must have a depth of at least 3 ft. below the level of the spillway at a point 150 ft. upstream from the dam. This regulation is wholly within the discretion of the Commission and may be altered one way or the other, as justified by the magnitude of the operations of the mine. It has been found that when it is met a depth of six feet of water is obtained at the dam.

The basic principle of this dam is the relief of pressure rather than resistance to it. The most impervious part is the back-fill, the up-stream face of which is continually covered with a layer of very fine silt, 'slickens' as

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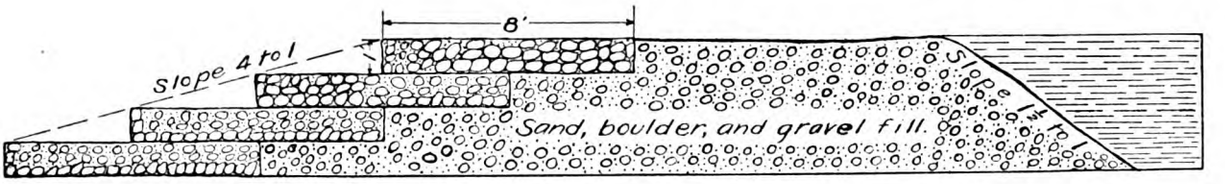

CROSS-SECTION OF THE DAM.

the placer-miner calls it. This silt makes the dam practically water-tight, but such water as does seep through makes its passage into the back-fill and spreads out in the many tiny open spaces therein or perhaps finds it way to the baskets. These are purposely made porous, so that the water which reaches them does not have a chance to accumulate and gain a pressure such as might eventually cause a failure of the structure, but gradually seeps through without resistance and discharges from the face of the dam under no pressure at all.

The step nature of the structure is also designed to offer a protection against erosion from floods. It will be noticed that every point on the face is protected by the thickness of two baskets. If a flood pours over the crest of the dam it is broken into a series of cascades, each one with only a drop of one foot and falling on two feet of the rock-filled baskets, so that obviously the damage from such a source would be slight.

In the spring of 1915 the dam was subjected to a severe and unexpected test of this sort when an unusually heavy and long-protracted season of rain brought a sudden flood down Scotchman creek. This poured over the crest of the dam continuously for five weeks. The flood was so unexpected that several broken boulders with sharp edges were left by the workmen on the crest of the dam. These were carried down the face in the first rush of the water and cut the wires of two baskets allowing, some of the filling to be washed out. It was five weeks before this damage could be examined and it was then found that the baskets above had weighed the others down and closed the opening formed by the escape of the filling so that no more boulders could work out, the displacement being distributed gradually through the other baskets, leaving the dam perfectly safe. It is here that the principle of the *jakago* comes into play, as it will also in case of the natural settling that may be expected of such a structure. But it is evident that it is impossible for any boulder of a size sufficient to injure the face of the dam to pass down the stream and through the several hundred feet of still water in the pond to the dam itself by any flood, however great.

The designer of this dam states that it is not the intention to expect it to act as a spillway for flood-waters except as may be occasionally required while the mine is in operation, and the dam itself is under the close oversight of those engaged in its construction. The Debris Commission requires that all dams not made of concrete shall be so constructed with a permanent bedrock or concrete spillway as forever to divert the flood-waters in such a manner as to guarantee the continuous storage of the tailing. The spillway required is proportioned to the precipitation and the area of the watershed, with a large factor of safety. In the case of the Omega it will be cut through the slate bedrock and will have a capacity of 2000 sec. ft., a factor of safety of 10, as the drainage-area of Scotchman creek is small and it is not expected that its discharge will ever exceed 200 second-feet.

This will prevent any water from being carried over the dam, which has not been designed with the idea that it will act as a permanent spillway. However, there seems to be reason to believe that the dam would be satisfactory even if put to this test. At first thought it might seem that its usefulness would be limited by the life of the baskets, that when the wires rust the baskets will fail, and the structure gradually disintegrate. But on further consideration it is reasonable to suppose that the constant percolation of silt-laden water through this basket-work will have a tendency to cement the loose gravel and boulders. It has also been found that the water which comes down from the mine carries a considerable amount of iron oxide, one of the commonest of nature's cements, in solution. This iron oxide is deposited from the water and one can observe this process of cementing going on to a limited extent at present.

That this dam is performing the service for which it was designed is evident from the fact that not only the tailing from the mine but the natural sediment of the creek is impounded. The water discharged actually contains less sediment than it did when the mine was not operating and there was no dam. I am indebted to J. M. Howells, C. E., of San Francisco, designer of the dam, for assistance in collecting and preparing these notes.

Seepage in concrete and in mortar-lined canals is discussed in the *Reclamation Record* for June. Experiments were conducted by H. D. Newell, manager for the Umatilla project on several canals with a 1½-in. lining of a 1:4 mixture of cement mortar. Accurate measurements showed the loss from seepage in a stretch of canal over two miles long to be negligible. Another experiment indicated that a three-inch lining of 1:3:3 concrete was more impervious than a 1½-in. lining of 1:4 mortar.

One of the largest pumping-plants in the world is being erected for the Egyptian government, to drain Lake Mareotis, near Alexandria. The plant will consist of eighteen Humphrey pumps, each capable of delivering 100,000,000 gallons of water per day against a head of 20 feet. Each pump is 8 ft. 8 in. in diameter.—*Canadian Engineer.*

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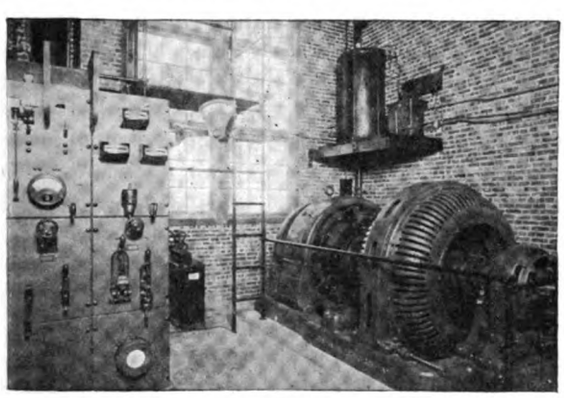
Electrification of Great Falls Terminal on Chicago, Milwaukee and St. Paul Railway*

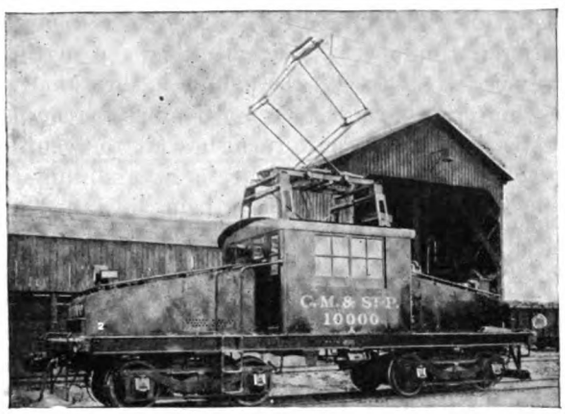
As a forerunner of the 3000-volt, main line electrification, the Chicago, Milwaukee & St. Paul Railway has recently begun electrical operation of the terminal line in the city of Great Falls, Montana. This city is at present the terminus of the new 138-mile feeder line from Lewistown, Montana, connecting with the main-line transcontinental division at Harlowton, the eastern terminus of the 3000-volt electrification now under construction. The Great Falls Terminal yards are situated in the centre of the city and are connected by a crosstown line, about four miles in length, known as the Valeria Way line. There is about three miles of additional electrified trackage, making a total of seven miles. The terminal buildings include a large freight-house, roundhouse, power-plant, and passenger-station. The tracks connecting the Falls yards and the terminal yard pass through the business part of the city; and it is expected that considerable benefit will be derived from the elimination of steam-locomotive smoke from the centre of the city, as well as a reduction in the cost of train haulage. The traffic includes the transfer of both freight and passenger trains from the Falls yards to the terminal station, as well as switching service in the terminals.



SUBSTATION EQUIPMENT.

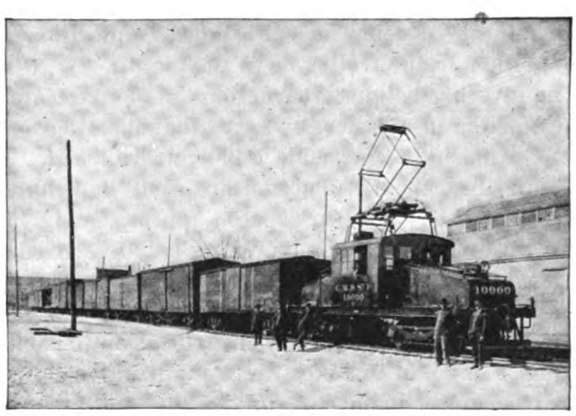
The electrical equipment is of sufficient capacity to take care of 580-ton freight-trains operating at about 9½ miles per hour on the maximum grades of 0.65%. Electric power is supplied by the Great Falls Power Company from the hydro-electric plant at Rainbow Falls, about six miles from the substation. Energy is transmitted at 6600 volts, 3 phase, 60 cycles as generated at the power-station.

The substation equipment is situated in the power-station operated by the railway company for heating the terminal buildings, and includes a two-unit, synchronous motor-generator set with a two-panel switchboard for controlling the alternating and direct current units. The motor is rated 435 kva. (0.8 power factor), 6600 volts, and operates at 900 revolutions per minute. Provision is made for starting as an induction motor through a compensator, which is operated from the alternating current panel. The generator is of the commutating-pole type, rated 300 kw. at 1500 volts. The set is capable of carrying 200% overload, or 900 kw. for a short time. Excitation for the alternating-current motor-fields and for the shunt-fields of the direct-current generator is furnished by a 10 kw., 125 volt, direct-connected exciter.



1500-VOLT ELECTRIC LOCOMOTIVE.

The switchboard consists of two slate panels, one controlling the synchronous motor and the other the direct-current generator and feeder. The direct current panel is a standard 1500-volt type, carrying remote control, hand-operated switch and circuit-breaker mounted between slate barriers at the top of the panel. The motor-panel contains the usual instruments and starting and operating switches for controlling the



LOCOMOTIVE AND TRAIN.

*From data furnished by General Electric Company.

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motor. An aluminum-cell lightning-arrester is also installed in the station as a protection against electrical storms.

All trains are handled by a standard, 50-ton electric locomotive of the steeple-cab type, designed for slow-speed freight and switching service. The running gear consists of two swivel equalized trucks, carried on semi-elliptic equalizer-springs. The driving-wheels are of solid rolled steel, 36 in. in diameter. The motor equipment includes four 750-volt, box-frame, commutating-pole motors insulated for 1500 volts. Each motor has a normal one-hour rating of 79 hp. at 750 volts, and two motors are connected permanently in series.

The gear reduction is 64/17. The control equipment is arranged for operation from either end of the cab. There are ten steps with the motors in series and seven steps in series-parallel. A multivane fan carried on an extension of the shaft furnishes air for ventilating the motors. The current collector is a sliding pantograph, similar to that which is being installed on the main-line 3000-volt locomotives. The slider is lifted into position by air-pressure and is held against the wire by steel coil-springs. Provision is made for operating at trolley heights varying from 17 to 25½ ft. above the top of the rail. Compressed air for operating the air-brakes, whistles and sanders is supplied by two 1500-volt, motor-driven air-compressors. Each of these units has a displacement of 27 cu. ft. of air per minute at 90 lb. pressure. The compressors are located in the cab of the locomotive convenient for inspection. A headlight, provided with a concentrated-filament Mazda lamp of about 100 candle-power, is mounted on each end of the locomotive. As a safety precaution, no trolley wire is installed inside of the roundhouse. A connection is made in the cab of the locomotive for applying power to the locomotive through a length of special flexible cable insulated for 2400 volts. A double-throw switch in the locomotive-cab allows connection to be made either to the trolley or to the circuit.

The overhead line-construction is of the catenary type, similar in a general way to that installed on the Butte, Anaconda & Pacific 2400-volt railroad. Both span and bracket construction are used, depending on local conditions. Poles are spaced approximately 150 ft. apart on tangent track, supporting a 4/0 grooved trolley from a 3-point suspension. There is no feeder-copper installed.

The work was done by the electrification department of the Chicago, Milwaukee & St. Paul railway, R. Beeuwkes, engineer-in-charge, under direction of C. A. Goodnow, assistant to the president. All of the electrical apparatus, including locomotive, substation-equipment and line-material, was furnished by the General Electric Company.

Total area cropped on the various reclamation projects during 1914 is stated in the *Reclamation Record* for June to be 703,424 acres. Irrigated land not cropped brings the total irrigated area up to 761,271 acres. The principal crop is alfalfa, with 329,676 acres.

INCREASE IN PETROLEUM PRODUCTION

The quantity of petroleum produced in the United States during the first half of the year 1915 is conservatively estimated by J. D. Northrop of the United States Geological Survey at 145,000,000 barrels. His apportionment among the major fields is as follows:

Regions.	Bbl.
Appalachian	11,300,000
Lima-Indiana	1,800,000
Illinois	9,000,000
Kansas and Oklahoma	58,000,000
Northern Texas	3,500,000
Northwest Louisiana	7,600,000
Gulf Coast	7,500,000
Wyoming	1,500,000
California	44,700,000
Miscellaneous	100,000
Total	145,000,000

This quantity which includes a considerable amount of oil placed in field storage since January 1 (chiefly in the Mid-Continent region) represents approximately one-half the total above-ground production credited to 1914 though disclosing a notable increase when compared with the production during the corresponding period in that year. When it is considered that the average market value of crude petroleum at the wells in the half-year just closed was 40 to 50% lower than that one year ago, this condition appears somewhat anomalous. Two factors, however, explain the situation, the Cushing field and new pools elsewhere.

During the first half of 1914 the output of petroleum from the prolific Bartlesville sand in the Cushing field, Oklahoma, increased from a few hundred barrels on January 1 to nearly 140,000 bbl. a day by the end of June. During the first half of the present year, however, the estimated production from all sands in this pool alone has at no time fallen below 200,000 bbl. per day, attaining at times an estimated daily yield as high as 280,000 bbl. Though the first half of 1914 witnessed the opening of the Colmar and Murphy pools in Illinois and a notable development in the Cushing and Healdton pools, Oklahoma, the increased output resulting was more apparent during the second half of the year than the first. In 1915, however, the early discovery and rapid development of the Crichton pool, Red River parish, Louisiana, the Thrall pool, Williamson county, Texas, and the Strawn pool, Palo Pinto county, Texas, served to increase appreciably the petroleum output credited to the first half of the year. The persistent flood of low-priced but relatively high-grade oil from the Oklahoma fields prevented any permanent advances, though temporary fluctuations were noted, in the market for grades of petroleum from other regions during the half year in review and the period closed with a fairly steady demand on the basis of $1.35 for Pennsylvania grade, the market standard. The corresponding period in 1914 recorded a notably unstable and declining market, prices of Pennsylvania grade decreasing in the period from $2.50 to $1.75 per barrel.

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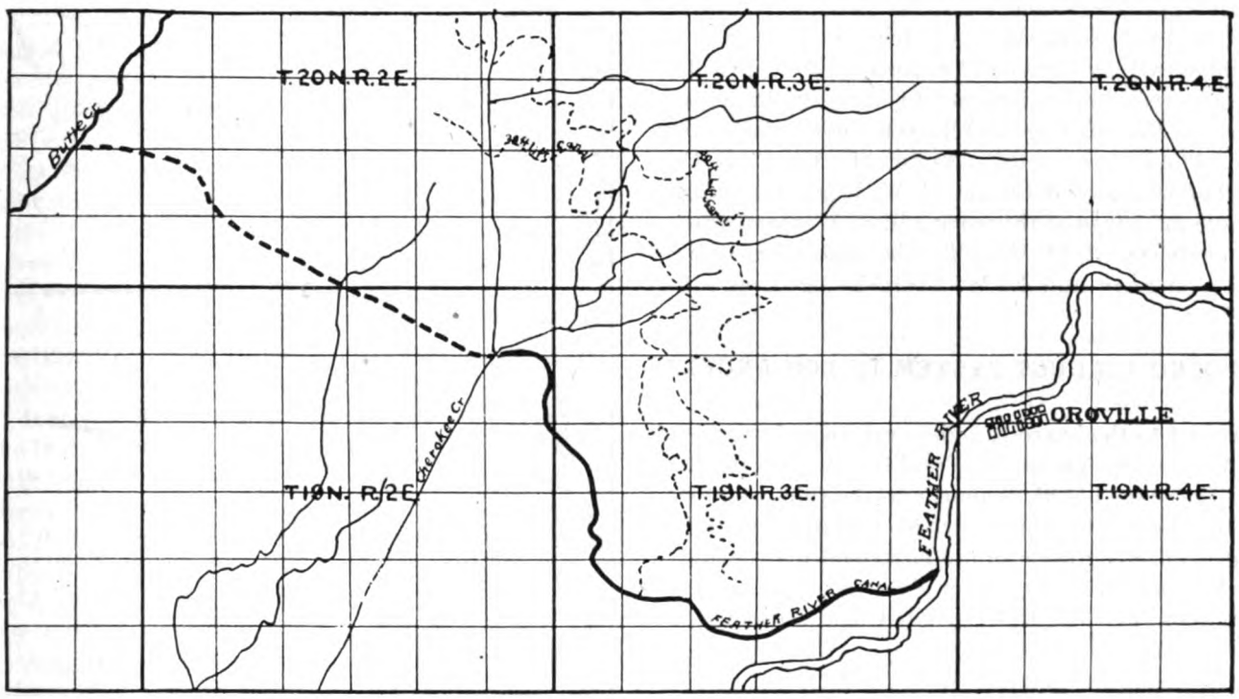
The Feather River Canal Near Oroville, California*

On May 20 last the Feather River canal was formally opened. The project was originally conceived by S. J. Norris of Oroville, who made the original filings in 1908. It later passed into the hands of the Brown-Walker-Simmons company and was finally taken over by the Great Western Power company in December 1914. But little actual construction had taken place before that time, but since then work has gone ahead rapidly under the direction of the Western Canal company, a subsidiary corporation of the Great Western Power company.

The most interesting feature of the construction of the canal was the use of the work that had already been done by the gold-dredging companies. A few years ago the dredging companies constructed a diversion channel several miles long from a point on the Feather river three miles below Oroville. The river during low-water was turned into this channel and the main river-bed dredged, as well as a good deal of the surrounding country. After this was done, the entire tract was apparently useless to everyone, and would have remained so were it not for the canal project. The canal company acquired the tract and used a part of the diversion channel for the upper part of the canal. When the dredges had finished work, the silt was left at the bottom and the gravel and cobbles on top, the latter materials being roughly graded as to size. As a result the proportion of voids was increased.

Consequently the bed of the river is now several feet higher than before being dredged. At the same time the silt brought down by the river is gradually filling up the voids in the dredged deposit. The several miles of dredged river-bed thus acts as a natural diversion dam for the canal during low water.

At high-water, on the other hand, the flood-discharge of the stream spreads over a considerable area and flows across the canal-banks for some distance. As the banks of the canal are composed of gravel and cobbles, while the bed of the canal is in the underlying silt, there will be little or no erosion from this cause. The wetted section being in silt, seepage losses will be small. It is expected that the current will be sufficiently strong on this portion of the canal to remove a good deal of silt, undercutting the banks and causing some of the gravel and cobbles to fall into the bottom of the canal. This should ultimately result in the entire canal section being lined with material not subject to erosion.



MAP OF PROJECT.

The headgate is of permanent construction and is situated a few miles below the intake. From the headgate the canal extends in a generally northwesterly direction to Cherokee slough, a total distance from the intake of twelve miles. It is expected that the canal will be continued during the present year to Butte slough, eight miles further and ultimately to the Sacramento river. From the headgate the canal is above the overflow from the Feather river.

The canal is built on a grade of ten inches to the

*From data furnished by George L. Walker, Crocker Bdg., San Francisco.

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mile. Its present width is 16 ft. on the bottom, but it is to be enlarged to a width of 50 ft., with a depth of 8 ft. Pumping plants will be built to raise the water in two 20-ft. stages and cover an additional acreage. The proposed canals from these pumps are shown on the map by dotted lines. The canal at present carries water for 20,000 acres but it is expected that it will ultimately serve 200,000 acres, part of which is suitable for rice and part for olives. Water will be obtained both from the normal flow of the river and from the stored flood-waters discharged from the reservoir of the Great Western Power company at Nevis, about seventy-five miles above Oroville.

The lower part of the canal from the headgate down was excavated by steam-shovels and by teams and scrapers. This portion of the work presented few novel features. Although about 1,250,000 cu. yd. of material was excavated, of which 500,000 cu. yd. was moved by dredges, 350,000 cu. yd. by steam-shovel, and 400,000 cu. yd. by teams and scrapers. T. K. Beard, of Modesto, was the contractor for the dredging, and Daniel Bayless, of Biggs, for the remainder of the earth-work. The concrete work was done by the Chico Construction company of Chico. F. W. Eggleston was the engineer in charge of the work and P. W. Ham was the chief engineer. J. M. Howells was consulting engineer for the company and E. W. Beardsley, general superintendent.

PROPOSED VIADUCT SYSTEM IN LOS ANGELES

A report to the board of public utilities of the city of Los Angeles, prepared by Franklin D. Howell, chief engineer for the board, recommends the following measures for the elimination of grade-crossings and the relief of traffic-congestion in the industrial district.

1. Steam-railroad tracks at street-level, but to cross streets only, and not to be granted longitudinal rights along same.

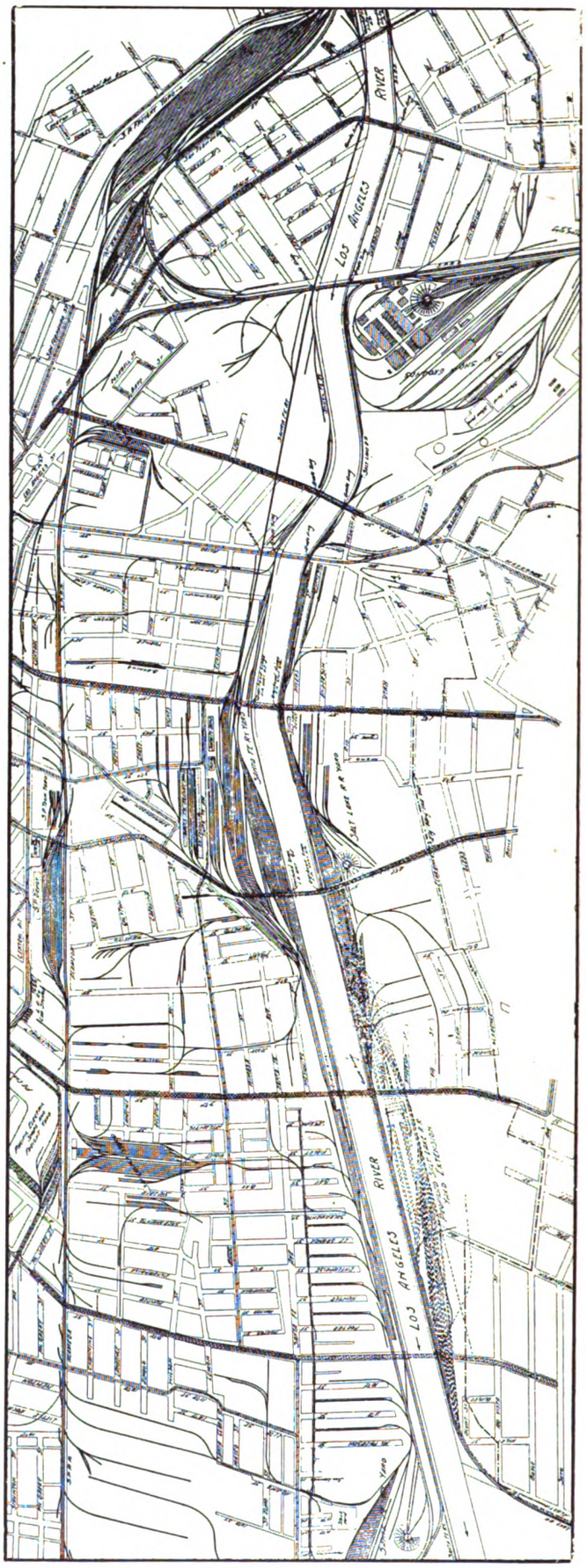
2. Grade to be established along the river suitable for railroad grade to accommodate the industrial district; railroads now on the river banks to be required to conform to same; all structures crossing the river to be adjusted to yield a standard clearance above or below such grade.

3. Interurban-railways to elevate or depress tracks as local conditions require, and to be removed from the surface of the streets.

4. Street-railways to use viaducts across the industrial district, and subways through the retail district.

5. Viaducts at all principal thoroughfares across the industrial district to accommodate vehicles and street-cars.

The report recommends the immediate construction of the viaducts shown on the accompanying map, namely at Main street, Macy street, First street, Fourth street, Seventh street, and Ninth street. The length of these viaducts will be from 4150 ft. up to 6750 ft., with a total length of 35,550 ft. in the six structures. The total estimated cost is $4,260,000.



MAP OF LOS ANGELES INDUSTRIAL DISTRICT.

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Sliding Royalties for Oil and Gas Wells*

By ROSWELL H. JOHNSON†

Sliding or graduated royalties are arranged either by the block, period, cumulative, or class method. The block method calls for a low royalty-rate on all oil produced up to a certain amount. This amount is usually that which is believed to be sufficient to repay the cost of the well. A higher rate is charged after the well is making a profit. This method, common in many industries, is inadaptable where the productivity per day of the units gradually and inevitably decreases. This is particularly true of the oil industry, because, for reasons given later, it forces an early abandonment of the well and so offends against conservation. In the period method, the royalty-rate is changed by some definite amount when the well produces less than a specified quantity per day or other given unit of time. While simple to explain, it operates badly because a great deal depends upon a small reduction in production, whereas the production as a matter of fact declines rather erratically owing to the exigency of lease management, to storage facilities, and to vagaries of the gaugers. These disadvantages are obviated by the cumulative method. In this method, all the production less than a certain amount per week has one rate of royalty, or none at all, and the oil produced in excess of that amount pays an additional rate of royalty. In the long run the calculation is probably no greater than with the period method, for simple tables can be prepared, enabling quick readings to be made. Even without the table the calculation is easy with the few royalty rates that would be used. In this method, the amount paid in royalty declines gradually, rather than suddenly as in the period method.

The following reasons might be advanced for the adoption of cumulative royalties:

1. To distribute the burden in accordance with the capacity to pay. This principle is a unique one in business, although familiar in taxation. This is because it does not distribute reward in proportion to efficiency. To fail in this is to allow an industry to degenerate in its progressive and alert attack on the technical and economic problems of the business. It is not then to produce a more equal and less just distribution of wealth among producers themselves, that the cumulative royalty is here urged.

2. The fear has been expressed that if sliding royalties are adopted, too steep a graduation might be used, which would have the effect of destroying the occasional high rewards essential to the producer to recoup him for the heavy expenses of the inevitable proportion of dry holes. Such a result would necessitate a great increase in the cost of oil to the consumer to produce higher profits on small wells in order to cause the producer to continue his activities. Such a result would be a social loss, but the fear in my opinion is not justified, for the landowner would not get such steep sliding royalties unless he consented to a reduction in his bonus, which he would usually prefer not to do.

3. Another advantage of the cumulative royalty is to prevent the excessive flat royalties now offered frequently for promising land, such as 50% on the Cimarron River bottoms and 25% occasionally in other fields. These royalties always lead in a few years to unpleasant threatening and bargaining between land owner and lessee, resulting in successive agreements to reduce the royalty rate. This awkward process, it is true, does accomplish a gradual reduction of the royalty rate. But the asperities of such negotiations are annoying and sometimes lead to premature abandonment of the well with consequent serious offense against wise conservation. The cumulative royalty, while avoiding the difficulties just referred to, still retains a flexibility, by virtue of which the producer who desires to do so, may increase the royalty rate, when the well can stand it, in this simple way transferring some of the speculative profits to the land owner in lieu of bonus. This bonus the producer may not be able to pay, or the land owner may prefer not to accept.

4. The fourth reason is the most weighty. The cumulative royalty lengthens the life of the well and increases the proportion of the oil which is recovered. If the royalty is one-sixth and maintenance and the interest on the junk is 83⅓c. per day, then a well must be abandoned when its net income to the producer reaches that amount. Yet the gross income is still $1 per day, and if the decline of the well is one-sixth in a year it might continue to produce for a year longer except for the royalty. Thus, 300 bbl. per well might easily be saved by a mere royalty adjustment.

A fourth method using a sliding rate is the class method. Here the wells are classified at the beginning and a different rate used with each class. The classification is based upon the ratio of value of product to the cost of production. Normally some one variable factor in either of the items above would be the basis of the sliding. The one which will be most used and which I recommend is the depth of the well. To charge the same royalty rate for wells of 600 ft. as those of 3000 ft. has the effect of promoting post-hole drilling, as we call wells of inadequate depth. Such a wide distribution of shallow dry holes, where the untouched underlying strata are worthy of test, results not only in a direct waste, because the area must later be re-

*From paper to be presented at the San Francisco meeting of the American Institute of Mining Engineers, September 1915.

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drilled, but also in an indirect waste, because later operators, being in doubt as to the depth of the older wells, are afraid to risk drilling in territory thus improperly condemned. The classes should be few, and all wells in one pool should be in one or another of the classes. For instance, if one-sixth royalty be charged in the Osage Nation, then the deeper sands of the western Osage would not be as systematically or economically prospected, as would be the case if the royalty was graded by depth. I suggest one-sixth for oil in pools averaging above 2000 ft.; one-eighth from 2000 to 3000, and one-twelfth below 3000, for the present leases with their partly developed production. For the rest of the Osage Nation I would suggest one-eighth above 2800 ft. and one-twelfth below it. The system above outlined would encourage thorough prospecting.

The objection that the difference between one-twelfth and one-sixth is too great will arise in the minds of those who think only of successful wells. It seems none too great when one remembers the amount of futile drilling which must be paid for from proceeds of the successful wells. To consider next the requirements of a proper system of sliding royalties:

1. It must be simple, so that it can be readily understood.

2. It must not be difficult to calculate.

It follows from these two considerations that it should have but few rates.

3. It must avoid uncertainties as to the time or point of changing rates.

4. Most important, it should permit the well to be pumped until its gross income has fallen to its maintenance cost.

To accomplish this last, I suggest an exemption from royalty on the oil equal to maintenance and the interest on the junk. The slight loss to the landowner will be met ordinarily in the bonus, but sometimes by a higher royalty. For practical reasons the amount that should be exempted, instead of being equal to maintenance and interest on the junk, would be fixed for the field at an integral number of barrels, ordinarily one. When several wells discharge into one field-tank, they may be averaged.

5. It should not encourage post-hole drilling as opposed to thorough prospecting.

6. It should bear some relation to the cost of production.

For these two reasons we should in addition classify the royalty according to depth.

The objection which might be raised that the landowner would in some cases receive nothing for the use of the land during the last months of the life of the well is met by the fact that he has received advance payment for such use either in bonus or in large royalty during the early history of the well.

In some fields gas may be so cheap and wells so isolated that it is not feasible to meter from the lease. But where a gas royalty is paid, or is indicated as the better method, the general principles laid down above apply in even a greater degree than to oil. This is because gas-wells are frequently abandoned because the production is not enough to pay the fixed rental for a well; also because it is the small wells about to be abandoned that have especially heavy maintenance sometimes by reason of the necessity of pumping water, or more often of installing pumping stations to keep up the pressure on the lines. To meet this situation I recommend a stated royalty for gas-wells, with the exemption of a certain amount per week, roughly estimated in advance, equivalent to cost of maintenance and interest on junk. This exemption is to be increased if water-pumps are used at the well or if pumping plants are required to raise the pressure sufficiently to put the product into the main lines.

We conclude, then, that the flat royalty offends against a wise development of our oil and gas deposits.

CONCRETE-PAVEMENT CONSTRUCTION IN SIOUX CITY, IOWA

Unusual methods of concrete-pavement construction are described by T. H. Johnson, assistant city engineer of Sioux City, Iowa, in a recent number of *Engineering News*. The usual precautions are taken to insure maximum density and a good soil-foundation, and a six-inch pavement of a wet 1:2½:4 mixture is laid. This is floated with long-handled wooden floats weighing 18 lb. each. At this point, instead of laying a wearing course of a richer mixture, or otherwise finishing the pavement, a dry mixture of one part cement and one part fine aggregate is sprinkled over the surface in sufficient quantity to absorb all surplus water. Heavier floats are then used until the dry mixture is thoroughly incorporated with the rest of the pavement. After setting has commenced, a third 'floating' is given the pavement, being continued as long as the setting will permit.

This additional dry mixture takes up most of the 'free' water contained in the wet-mixed concrete. It is generally recognized that it is the voids left by the evaporation of this 'free' water that cause many of the shrinkage cracks in concrete pavement. On the other hand, concrete mixed with a comparatively small amount of water will not flow freely enough for use in most classes of construction, particularly pavements. By adding the dry mixture it is possible to mix the main body of the concrete wet enough to flow freely and still avoid most shrinkage cracks. To further guard against cracking, transverse joints are placed every 25 ft. and longitudinal joints along the curbs.

About 30 miles of concrete pavement has been laid in the city, some of it on 16% grades. Some of this pavement has been laid for several years, but less than 2% of the 25-ft. sections have developed cracks. The cost of the pavements laid recently has ranged from $1.02 per sq. yd. when the materials were hauled two-thirds of a mile, up to $1.14 per sq. yd. when they were hauled 1½ miles. Crushed rock cost $2.10 per cu. yd., sand $1 per cu. yd., and cement $1.04 per barrel. The average labor cost for mixing and placing concrete and finishing the pavement was $0.12 per square yard.

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The Water-Supply for the Klondike Hydraulic Mines*

By H. H. HALL†

While the earlier discoveries in the Klondike region were along the creeks where a water-supply was easily made available, it was soon found that much ground at a considerable height above the streams contained enough gold to make hydraulic mining a profitable venture. To provide a water-supply, the Yukon Gold Company constructed the works hereinafter described. The project involved the construction of seventy miles of conduit from the Ogelvie range of mountains southwesterly to the Klondike mines near Dawson City, for the purpose of conveying 125 second-feet of water, or about 80,000,000

EXCAVATING DITCH WITH TEAMS.

EXCAVATING DITCH WITH STEAM-SHOVEL.

gal. per day. The region traversed lies behind the great Alaskan range of mountains, which are nearly 20,000 ft. high, and cut it off both from the warm, moist air of the Japan current and also from the severe wind storms common along the Alaskan coast. The temperature ranges from 43° to 68° below zero in January to 60° to 95° above zero in July. The country is a low, rolling plateau cut by minor mountain ranges seldom exceeding 7000 ft. in height. It abounds in spruce timber growing as large as two feet in diameter in the river bottoms, but on an average four inches in diameter and 20 ft. high. The top layer of ground is frozen mud, or muck, composed of decayed vegetable matter, frozen as deposited and varying in depth from nothing to several hundred feet. This is overlaid by a blanket of moss often a foot or more in thickness, which has the effect of preserving the muck in a frozen condition throughout the year. The chief economic assets of the country are gold and coal, but on the southern slopes, whenever the timber and moss have been burned off, the ground thaws rapidly, and grasses, vegetables, and wild berries grow profusely.

The conduit comprised 21 miles of flume, 37 miles of open ditch, and 12 miles of pipe, constructed under separate organizations during three seasons of about 120 days each, from 1907 to 1909.

Ditch construction was used wherever possible. The

NATIVE TIMBER USED DURING CONSTRUCTION.

ditch was made seven feet wide on bottom and 3½ ft. deep with 1½ : 1 slopes. The gradient ranged from four to seven feet to the mile, the greater portion being six feet. The ditch was carefully placed so as to bring the entire working-area in cut. The right-of-way was first cleared of trees, and the muck scraped off with teams and slip scrapers as fast as it thawed. The latter work presented the most troublesome problem from a construction standpoint owing to the uneven thawing of the muck and the consequent miring of the horses. In some cases, upon the removal of two or three feet of muck from a slope of mixed clay, gravel and ice, the thawing of the upper bank thus exposed started a small slide. This would break the moss above the ditch and allow more thawing, until a strip as much as 200 ft. wide and a quarter of a mile long would start to slide slowly down on the right-

*Abstract of paper read before the San Francisco Association of Members of the American Society of Civil Engineers, April 16, 1915.

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of-way, carrying trees and vegetation with it. No preventive was discovered for this.

Thirty miles of ditch was dug with six 30-ton steam shovels, the remainder with horse scrapers. As the shovels required a working-space at least 16 ft. wide, no side-sloping was done with them. Small quantities of frozen material were removed with 40% dynamite but the larger patches were passed over, and after thawing were taken out with scrapers. The shovels worked two 10-hour shifts and burned about three cords of wood per day. The record performance for one shift was 410 lin. ft. of ditch, or 1200 cu. yd. and the average performance was 14.7 lin. ft. or 51 cu. yd. per working hour, or 11.2 lin. ft. or 38.7 cu. yd. per available hour. The season lasted from June 15 to about October 15, with work usually slow the first and last weeks, 100 working days being about the true season-length. The teams and scrapers accomplished from 8 to 20 yd. per horse-day, averaging about 15 yd.

4 Ft. x 6 Ft. FLUME COST EXPRESSED IN MAN DAYS, (10 HOURS) PER LINEAL FOOT OF FLUME.

Item.	Man Days.	Remarks
Lumber Hauling.	.159	
Under-Pinning.	.105	Equals about .017 Man Days per Lin. Ft. Round Timber.
Survey.	.025	Includes Preliminary.
Clearing.	.025	Trees only, equivalent to 11 per acre.
Excavating.	.139	Equals about 5 per Cu. Yd.
Bent Construction.	.094	
Back Filling.	.016	
Miscellaneous.	.125	
Flume Construction.	.145	
Superintendance.	.014	
Total.	.847	

General Expense amounted to about 4% of total cost.

TABLE OF FLUME COSTS.

While the actual cost per lin. ft. of ditch was about the same for shovel-work as for scraper-work, it should be remembered that the number of horses in the region was limited. To attempt to construct the entire ditch with horses would have either delayed the completion of the project or else compelled the importation of a large number of animals. The latter course would have added greatly to the cost of the work. The use of steam-shovels was therefore a much greater saving than would appear at first sight from the cost-summary.

The finishing gang followed the shovels, truing the grade, sloping the banks, clearing the berms, building a path along the top of the spoil bank for watchmen, and constructing turnouts and overflows alternately every half-mile. In porous ground, the shovel gang endeavored to keep below grade and the finishing gang filled in the depressions with six inches of moss and a covering of top soil. In soluble materials a trench was dug against the lower bank, extending two feet below grade, and a layer of sheet piling placed over the side of the ditch with a single tie at the top, this piling then being covered with moss and top soil. The average labor cost of finishing per lin. ft. was 0.094 of a man-day plus 0.018 of a horse-day. Common labor was paid $4 per day and board, and horses were hired at $100 per month, including found. Under operation the ditch has proved satisfactory, leaks

YUKON GOLD COMPANY

MAIN PIPE LINES.

Name.	Kind.	Diam.	Length.	Head.	Max. Pres.
Little 12 Mile.	Wood.	49"	830'	95'	685
	Riveted Steel.	44"	3540'		
Ballarat.	Wood.	42"	13200'	158'	246
	Wood.	48"	800'		
Lepine Ridge	Wood.	48"	14800'	108'	133
Lepine Creek.	Wood.	49"	1924'	50'	490
	Riveted Steel.	47"	2160'		
Klondike.	Wood.	49"	2390'	200'	1039
	Riveted Steel.	49"	6850'		
	Welded Steel.	43"	7520'		
Quigley.	Wood.	46"	1600'	17'	193
Pure Gold.	Wood.	35"	1626'	21'	234
Mosquito.	Wood.	35"	1560'	22'	256
Bonanza.	Spiral Riveted.	42"	3175'	91'	364
	Spiral Riveted.	38"	3175'		
Adams.	Wood.	35"	1907'	30'	270

DATA REGARDING MAIN PIPE-LINES.

SUMMARY OF STEAM SHOVEL OPERATIONS SEASON OF 1908.

Shovel.	Start.	Finish	Total Hours. (20 per day)	Hrs. Lost Moving across pipe line, etc.	Avail Working Hours	Hrs. Lost. Repairs, Accidents, Blasting	Hours Worked.	Total Lineal Feet.	Total Cubic Yards.	Lineal Feet Per Hour Worked.	Lineal Feet Per Available Hour.	Cubic Yards. Per Hour Worked	Cubic Yards. Per Available Hour	Remarks.
I Vulcan "Little Giant"	July 2nd	Aug. 19th	970	○ 50	920	44	876	11,296	36,356	12.9	12.3	41.5	39.5	○ Crossing Shovel Creek and Sloughs.
II Vulcan "Little Giant"	June 22nd	Aug. 16th	1100	○ 20	1080	174	906	12,270	50,857	13.5	11.4	56.2	41.1	○ Turning around. Shovel also ran back along ditch digging out high spots.
III Marion "20" (On Div III)	June 8th	Aug. 21st	1460	○ 100	1360	129	1231	● 23,095	82,663	18.8	17.0	67.1	60.8	○ 10 Shifts crossing Ballarat pipe ● 200' digging out flume bottom (Shovel moved to Div V)
III Marion "20" (On Div V)	Aug. 25th	Sept. 14th	410	○ 35	375	27	348	5,400	11,730	15.5	14.4	33.7	31.3	○ Moving along bank, rains, etc.
IV Victor	June 23rd	Aug. 24th	1250	○ 74	1176	462	714	8,975	32,031	12.6	7.6	44.9	27.2	○ Crossing Quigley Pipe. Shovel worked through rock, frost, and mud continuously 7/14 to 8/21
V Thew.	July 8th.	Sept. 14th	○ 1434	25	1409	833	576	7,106	26,096	12.3	5.0	45.0	18.5	○ 12 Hr. Shifts from 8/4 to 8/19. Shovel worked almost continuously through frost and rock
VI Vulcan "Little Giant"	June 22nd	Aug. 30th	○ 1190	——	1190	92	1098	16,340	50,851	14.9	13.7	46.3	42.7	○ 12 Hr. Shifts from 8/6 to 8/10. Shovel idle from 8/10 to 8/21 — crew on Shovel II.
Totals.			7814	304	7510	1761	5749	84,482	290,584	14.7	11.2	51.0	38.7	

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being usually caused by ice seams. These breaks cannot be refilled, and where they occur, flume construction has to be substituted. Caving banks were protected by brush laid lengthwise with tops upstream, held in place by stakes.

Where the side-slopes exceeded 15° or the muck was over 2 ft. thick, flume construction was adopted of board-and-batten type and was 6 by 4 ft. The flume was built of native lumber, made up in 16-ft. sections and set on

WEAK POINT IN DITCH, LINED WITH TIMBER.

trestle-bents of hewn timber 8 ft. centre to centre. Most of the bents were carried on mudsills laid below the black muck, or about four feet deep, great care being taken not to disturb the moss-blanket unnecessarily and to replace it as quickly as possible over the back-filling in order to preserve the ground in a frozen condition. Even at that

HYDRAULIC MINE.

the ground thawed so rapidly that the workmen were forced to work in mud and water. The cost of excavation was sometimes as great as $5 per cubic yard. Winter-work was tried, but the snow rendered it uneconomical. The bents cost nearly $20 apiece in place. An attempt was made to space the bents 16 ft. centre to centre, but this was found to be impracticable on account of the softness of the foundation.

The experiment was tried of supporting some of the bents on piles driven into earth that had previously been thawed out by means of 16-ft. miner's steam-points. In this manner the moss was broken only to admit the pile, and if allowed to stand a winter before water was turned in, the ground around the pile froze and returned to its original state. Where the depth of muck would require deep mudsill-pits, gravel ballast was placed directly on top of the moss and the flume-stringers were laid on ties as are the rails in railroad construction. The labor cost in man-days of 10 hours per lineal foot of flume were as follows: hauling flume lumber, 0.159; getting out timber for bents, 0.105; surveying, 0.025; clearing out trees, 0.025; excavating, 0.139; bent construction, 0.094; backfilling, 0.016; flume construction, 0.145; miscellaneous, 0.125; superintendence, 0.014; total, 0.847. Operation of the flumes for several years has shown that the pile-foundation is the best, the mudsill-bents showing continual settlement, caused by water flowing down the posts, either from the flume or from natural drainage, and thawing the sub-strata.

Pipe lines were employed for pressure sections. Their construction has been described by W. W. Edwards, in Proceedings of the American Society of Civil Engineers for May, 1914. For pressures not exceeding 200 ft., redwood stave-pipe was used; for pressures over 200 ft. and less than 1000 ft., standard riveted pipe; for pressures over 1000 ft., lap-welded steel pipe. One section was constructed of spiral-riveted pipe with patent bolted couplings.

Under operation it has been found that because of the lines being drained and closed from the first of October to the first of June of the following year, the wood pipe has given considerable trouble. This is particularly true where the pipe was left above ground, the staves drying out and shrinking, necessitating back-cinching practically the entire line before putting it in use each year. The water leaking between the dried-out staves tends to thaw the foundation, causing settlement and opening of joints. This makes a leak that is difficult to repair. As the pipe does not run full all the time, there is an accumulation of drift on the intake end. In spite of the use of grizzly-bars this has worn holes in the wood lines. Some staves have rotted. The sand and gravel carried by the ditch-water has worn the bottom staves badly and all intakes are now provided with sand-boxes. Accumulations of ice at the discharge ends have caused considerable trouble by increasing the pressure on portions of the pipe. The steel pipe has given little trouble, but on high-pressure lines the sediment cuts the steel rapidly and in one instance a ¾-in. rivet was cut away in two weeks.

Monel metal may be forged by heating it to a temperature of 600 to 900°C., or 1112 to 1652°F. It is preferable to heat the metal in a muffle furnace, although it can be done in a gas or oil-fired furnace where a neutral or slightly oxidizing flame is maintained, nearly free from sulphur.—*Mechanical World.*

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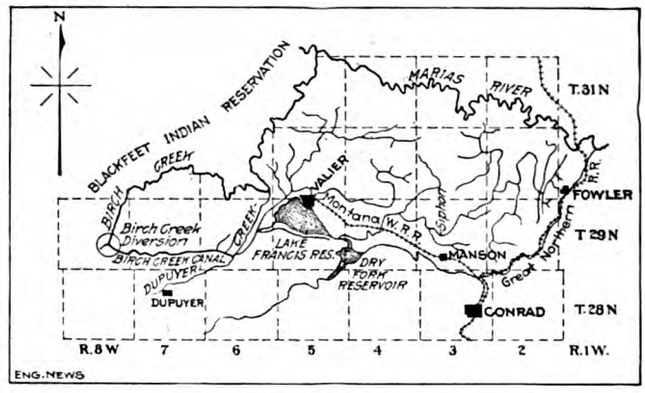
Construction of Dams on the Valier, Montana, Irrigation System

By KENNETT A. HERON*

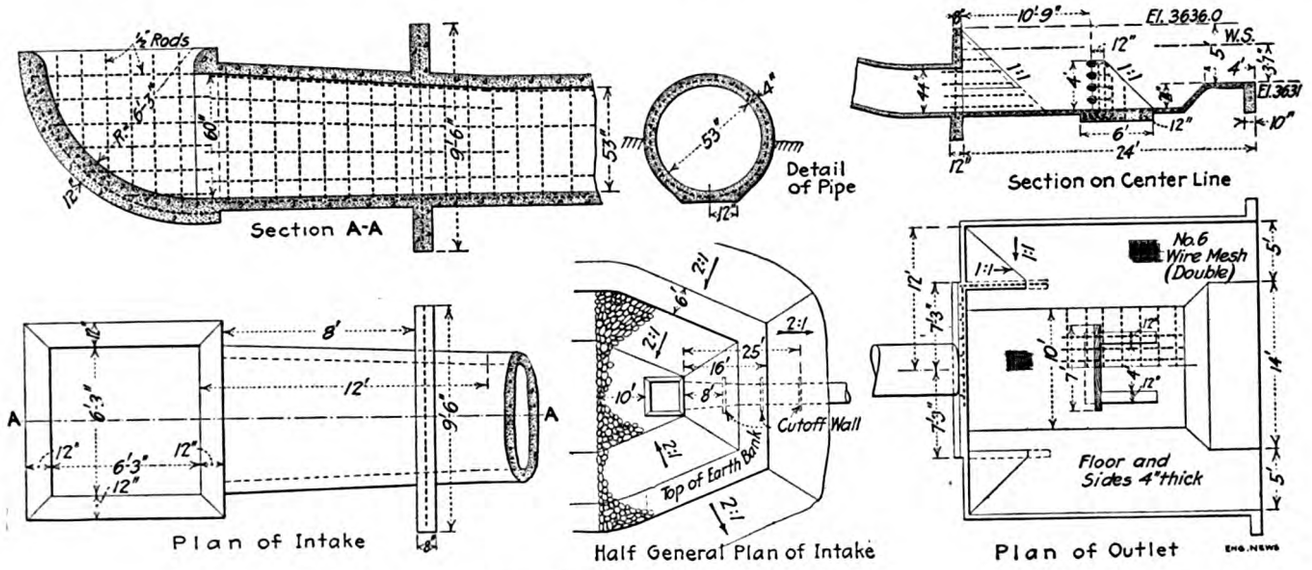
The recently installed irrigation system of the Valier, Montana Land & Water Company at Valier, Montana, is the largest in the state. Several parts of the system are of more than local interest. One hundred and thirty thousand acres of private and Carey Act lands adjacent to and north of the town of Conrad on the Great Northern railway are included in the tract placed under irrigation.

Swift Dam. The water supply is derived mainly from Birch creek, a mountain stream flowing the year around from the east slope of the Rockies. The creek drains an area of 185 square miles above the head of the diversion canal and 120 square miles of this area is above the recently constructed Swift dam. This dam is located in a narrow rocky canyon at a point where the stream leaves the mountains 35 miles southwest of Valier and consists of a concrete-faced rock-fill dam 159 ft. high. From the bed of the creek to the solid rock beneath ranges from 12 to 30 feet. This is filled with boulders, gravel, and sand, and the fill is on top of this material. The width of the canyon at the creek elevation is 80 ft., and at the top of the dam 470 feet. The fill has a slope of $1\frac{1}{3}:1$ on the downstream side, 15-ft. crown, and the top 59 ft. on the reservoir side is sloped $1\frac{1}{3}:1$. From this point, which is 100 ft. above the creek bed down to the bottom, the concrete facing has a slope of 1:1, but is covered by a loose rock-fill with 17.5-ft. crown at the 4805 elevation, and a $1\frac{1}{2}:1$ slope on the fill. The outer face of the fill under the concrete facing consists of hand-placed rock about 5 ft. thick. This is coated with a thin layer of cement-mortar to form an even surface. This surface is tarred and on top of this the concrete facing is laid. The facing is 18 in. thick at the creek elevation and 6 in. thick at the top. The top five feet consists of a concave-faced coping. Twisted $\frac{1}{2}$-in. square bars are used for reinforcement and are spaced four inches centre to centre vertically and four and five inches horizontally throughout the slope. Expansion joints are provided by placing planks on edge at a vertical distance of 50 ft. centre to centre. The rods extend through these planks. An additional fill 12 ft. high with 20-ft. crown was placed against the downstream toe of the fill to replace any possible wash caused by the discharge of the outlet valves. The dam is built on a curve arching upstream with a middle ordinate of 20 feet.



MAP OF PROJECT.

The outlet consists of a concrete-lined tunnel 7 by 8 ft., with an arched roof. The regulating-gates consist



REINFORCED-CONCRETE PIPE-DROP.

*Irrigation engineer, Modesto, California.

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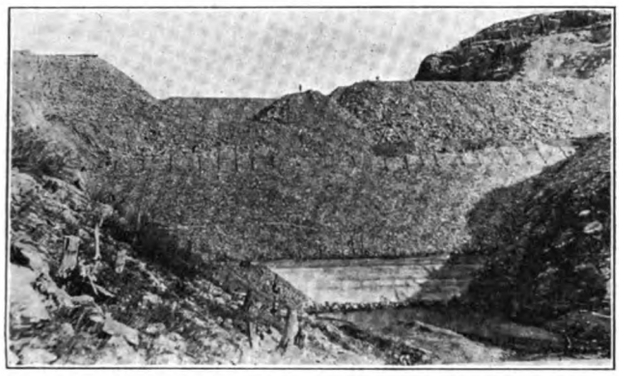
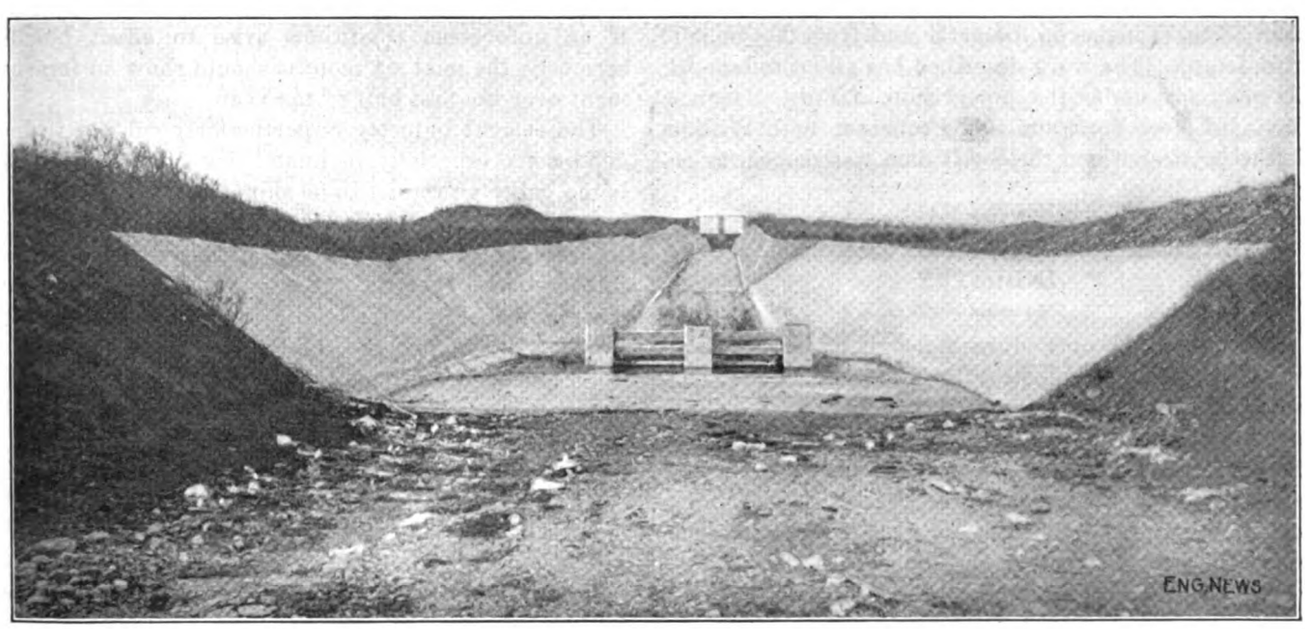
of four 36-in. gate-valves discharging at right angles to a 7-ft. steel pipe ½ in. thick. This extends 100 ft. into the tunnel and is embedded in concrete. A spillway weir 400 ft. long at elevation 4947 discharges into a concrete-lined channel 18 ft. wide and 20 ft. deep. This is situated about 600 ft. north of the main dam and near an auxiliary dike, which was built to prevent the storage above the 4920 elevation from escaping over a saddle about 700 ft. north of the dam. The dike is an earth and rock fill 40 ft. high and 450 ft. long. The reservoir side of the dike is a compacted earth-fill with



SWIFT DAM DURING CONSTRUCTION.

3:1 slope and rip-rapped with rock from the spillway excavation. The earth is backed by a rock fill with ¾:1 slope in front and 1½:1 slope in the rear. A concrete cutoff-wall extends to bedrock. The rock for the dike was obtained from the spillway excavation. The accompanying views show how the rock from the canyon walls was deposited in the dam. During construction the creek water was diverted through the outlet-tunnel, but at one time (May 1913) the water was so high that work had to be abandoned on the cutoff-wall at the toe of the concrete facing for several weeks. This wall extends 30 ft. below the creek bed and is 14 ft. thick up to a point 10 ft. below the creek elevation, where it is reduced to 18 ft. and conforms to the slope of the face of the dam. Some difficulty was encountered in keeping the cutoff-trench dry enough to place concrete and this work was quite slow. It was finally accomplished with the aid of one 6-in. and two 10-in. pumps.

Lake Francis Dam. The water from the Birch Creek reservoir flows down the creek 12 miles, where it is diverted by the Birch Creek canal, which runs easterly 14 miles to Dupuyer creek and empties into this latter, a short distance above the head works of the Dupuyer Creek canal, which in turn diverts the stream flow to the Lake Francis reservoir, three miles below the head of the canal. The Lake Francis reservoir will have a capacity of 112,000 acre-feet when completed and will cover 4500 acres. The development of the reservoir-site required a dam 60 ft. high at the lower end and an earth dike a mile long and having a maximum height of 20 ft., situated at the upper or western end of the reservoir. The dam has been completed and the company plans to raise the dike as fast as required. The Lake Francis dam was originally built by the Pondera Canal company some 12 years ago, but was washed out and when rebuilt showed considerable settlement and leakage. The present company reconstructed the dam at a cost of $35,000. It is now in first-class condition and somewhat larger than originally built. The dam is an earth structure 60 ft. high and 600 ft. long. The reservoir side is sloped 2:1 and rip-rapped with rock. The crown is 20 ft. wide and the upper third of the downstream side in 2:1, and the lower part 3:1. There is a concrete core-wall resting on steel sheet-piling. The core is 12 in. wide at the top and 41 in. at the bottom. An outlet composed of two 53-in. culverts controlled by two 48-in. valves



CONCRETE CHUTE.

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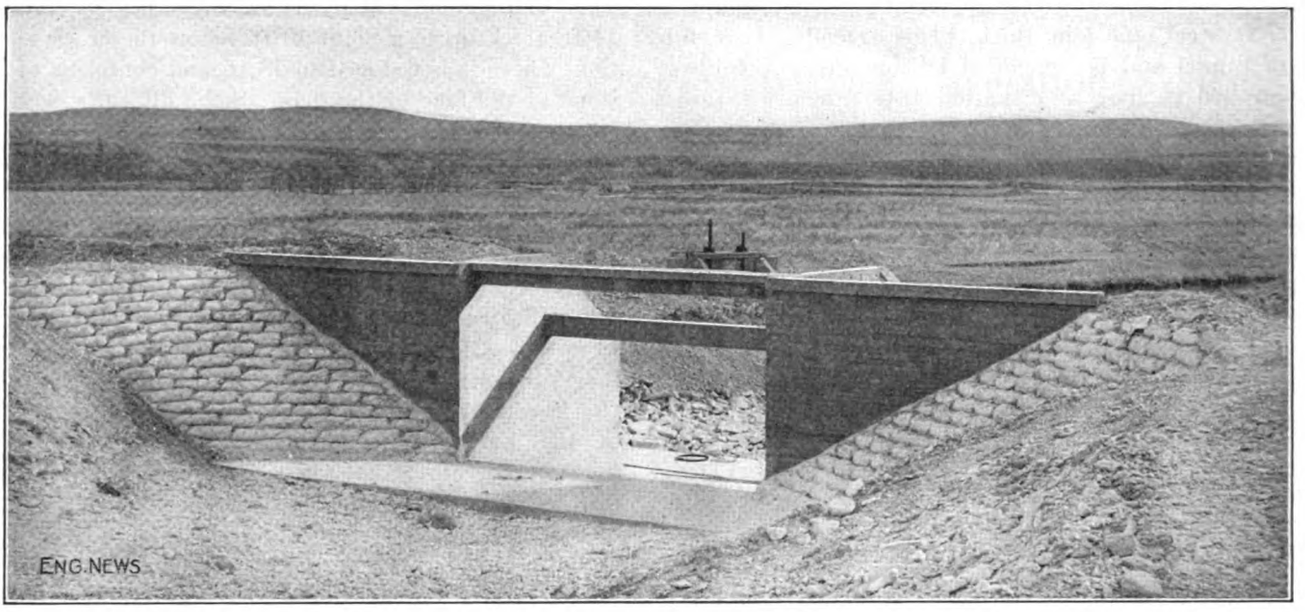

CONCRETE DROP.

originally discharged the stored water into the canals, but in reconstructing the dam the two culverts were replaced at the lower end by one 7-ft. culvert. A new gate tower on the upper end of the culverts was also constructed.

Concrete Pipe-Lines and Chutes. As the land to be irrigated slopes rapidly to the east and north, a number of 'drops' of various forms were constructed to deliver water to the lower levels. Where the fall was small, vertical drops of reinforced concrete were used, but in a number of cases where the fall was more than 10 ft., concrete pipes and chutes were built. Nine of these pipe-lines have been constructed of monolithic concrete, reinforced for both temperature and head. This kind of drop, while costing a little more to build than open chutes, has given the best results. The sizes in use vary from 36 to 58 inches in diameter and from 200 to 1800 ft. in length. The work described has all been done for the company under the supervision of Ford, Bacon & Davis, of New York and San Francisco, with William E. Swift, after whom the Swift dam was named, as engineer-in-charge.

GENERAL CONDITIONS IN THE CEMENT INDUSTRY

The year 1915 opened with decidedly slack conditions in the cement industry, the latter part of 1914 having shown a large falling off in production and a still larger reduction in shipments of portland cement than the corresponding period of the preceding year, as reported by E. F. Burchard, of the United States Geological Survey. The net result for 1914 was a slight decrease in both production and shipments, the first yet recorded. The average price at the mills also decreased. At the beginning of 1915 there was little new construction work in sight. Few cement manufacturers felt optimistic concerning the outlook and some even prophesied a further decline in volume of business for 1915.

The general developments of the early months of 1915 were not such as to dispel the gloom entirely, so that the rate of production of many mills was cut down below that of shipments in order to effect a partial clearance of the large stocks that had accumulated during 1914. In general, however, there has been an improvement during the second quarter of 1915. The rate of production of portland cement has gradually increased, and although there are no statistics available for the first half year it is believed that, as compared with the corresponding period of 1914, no appreciable gain or loss has occurred. If this be true, then conditions really are better than were anticipated by the majority of producers at the beginning of the year, and, if no unforeseen conditions arise to affect business seriously, the next six months should show an improvement over the first half of the year.

The cement industry is particularly subject to local conditions, especially in inland districts, since cement is too bulky a product to be shipped in great quantities by rail into competitive territory, except under extraordinary circumstances. Naturally, therefore, certain districts, such as those that produce cotton, and those in which industrial agitation has recently checked progress, have felt the depression more keenly than other parts of the country. In districts where large public works are in progress, or where advantage is being taken of the low prices of structural materials to push extensions of factories and new construction work, the production and shipments of cement have increased.

Dynamite freezes at a temperature several degrees higher than that of melting snow. A temperature of 35°F. is low enough to spoil its efficiency.

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OILED ROAD CONSTRUCTED AS DESCRIBED BELOW.

The Building and Maintenance of Oiled Roads*

By T. B. TWADDLE†

[Mr. Twaddle has been a member of the board of supervisors of Tulare county, California, for 23 years.—EDITOR.]

Before the effectiveness of the use of oil in our road making was realized, a large proportion of the money spent in road construction and repair was wasted. Undoubtedly the knowledge acquired through this experience has been valuable. At any rate it constitutes the greater part of the returns for the sums spent in road maintenance in many parts of California previous to ten or twelve years ago. In the early days, because of the lack of any effective binders in the road materials used, it was frequently the case that the annual repairs necessary on rural highways were almost as expensive as their first construction. This condition was rendered distinctly worse by the coming of the automobile, and if we had not discovered the effectiveness of heavy asphaltic oils in maintaining road surfaces, the problems of road supervisors would by this time have been extremely difficult. In my district, oil was first used on the highways about twelve years ago, and from that time until the present this use has been gradually increased until the method, that I will now describe, has come to be applied to nearly all of our roadways.

The concrete, asphalt, or macadam highway, costing $8000 or $10,000 per mile, is a desirable improvement on the great arteries of travel and between large towns. It is altogether out of the question, however, for a large portion of our country roads. Some less expensive, but at the same time effective, substitute had to be found, and I believe that experience justifies the statement that we have found this in a road surface made by the right application of asphaltic oil and sand. The first requisite is a good foundation. By this I do not mean that there should be a rock-ballasted road or rock foundation, but simply that the road must be properly drained and so crowned or rounded as to insure a quick and effective run-off of the surface water. Culverts of lasting material should be provided at the proper places. The road surface must be thoroughly compacted before any oil is placed. This is important, and neglect of this feature is frequently the cause of lack of success in road making with the use of oil. The means taken to secure a hard and smooth surface do not matter particularly; one method may be more available in one location than another. The great point is to secure an even, firm surface, with the proper amount of crown. The oil employed should be as heavy as can be applied without artificial heating and should contain 65 or 70% of asphaltum. Of course, such oil can be applied without heating only in the summer time.

My experience has been that the proper amount of such oil so applied is from 200 to 300 barrels per mile, according to the width of the oiled portion. This oiled portion should for the first year be about 14 ft. in width, and this width should be increased in the two subsequent years to about 18 feet. After the application of the oil, it should be covered at once with a layer of coarse sand, this being spread uniformly and as thickly as the oil will absorb. Next a heavy roller should be run over this sand coating, thereby firmly uniting the sand and oil with the foundation and thoroughly and firmly mixing the sand with the oil. This constitutes the first oil coating of the highway.

*From *The Highway Magazine.*
†Tulare, California.

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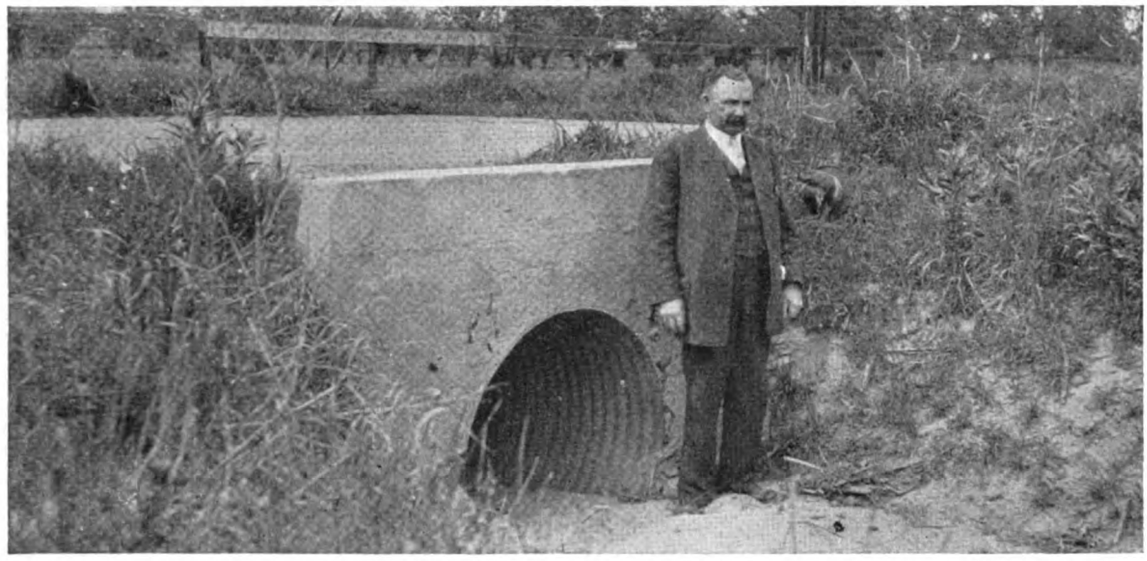

CORRUGATED CULVERT WITH AMPLE EARTH COVER.

A year later, similar treatment should be given to the road. There should be a coating of heavy oil, but less in quantity than that of the first year, and this should likewise be covered with a layer of sand, thoroughly and firmly mixed by the use of the roller. During the third year a similar treatment should be given it of heavy oil and coarse sand, the quantity of oil, however, being less than that of the second year. Before the treatment mentioned is given to the roads for the second and third year, the surface should be smoothed and leveled by the road machine. Placing fresh coatings of sand and oil on a roughened and rutted surface is largely a waste of good material. Owing to climatic conditions in the San Joaquin valley, and particularly in my own county, the surface of these oiled roads becomes uneven in course of time from what is termed 'buckling.' In order to get good service from oiled roads, it is necessary to remove this buckling. This can be accomplished by the use of a road machine made for that purpose. After the use of such a machine and the removal of the buckling, another coat of coarse sand should be applied to the road. The heat of the summer causes the oil to rise to the surface and the quantity of sand should be sufficient to absorb this oil. Thus by adding a little sand after each smoothing, the road becomes a practical highway, and one well adapted to the needs of a rural community.

The cost of putting a road in such shape with oil and sand upon a good foundation with a well-crowned surface is about as follows. For the grading, rolling, packing, and forming of the solid foundation the cost averages about $150 per mile. The first application of oil costs $1 per barrel upon the road, and the sand so applied from $50 to $100 per mile, depending upon the length of the haul. The cost for the first year, including the foundation and the application of oil and sand, would average about $500 per mile. The cost of the annual renewals of oil and sand during the second and third years would be from $80 to $100 per mile for oil and from $50 to $100 per mile for sand, making the average cost $200 per mile for these subsequent years. These figures are from my own experience. They would perhaps need some revision in other localities. It has been my experience that such oiled roads can be kept in repair by applying to them annually a thin coating of heavy oil, about 60 barrels to the mile, and followed up promptly by a layer of coarse sand. The total cost of such a road for the first three years would not exceed the sum of $900 per mile, and the cost of maintenance thereafter should not exceed $150 per mile per year on the more traveled highways. On highways less traveled, the cost of maintenance would be proportionately less, and the up-keep of a road in such condition would not in any event be greater than that of the high priced, $10,000 per mile, highway.

I have experimented to some extent with gasoline tractors for hauling oil and sand. If these are provided with broad smooth wheels they are themselves a benefit to the road surface, acting somewhat in the same manner as a roller. Those with narrower wheels with cleats are, of course, more or less destructive to it. The tractors certainly effect an important economy in the hauling of materials.

The oiled highway forms an excellent illustration of the truth of the old saying that "A stitch in time saves nine." A little intelligent work at the right time in the way of maintenance—a little smoothing and sanding of defective places—will avoid the necessity of heavy repairs at some later time.

In the Chicago terminal district there are 38 railway properties, 20 of which belong to trunk lines, 4 are outer-circle lines, and 10 belong to private firms. The total single line in this area is about 4000 miles. There are 1300 passenger trains daily, with 200,000 passengers, while 12,000 loaded freight cars enter and 10,000 leave. In addition to the loaded cars, about 15,000 tons of small consignments of freight enter, and about 10,000 tons are sent out.—*Mechanical World.*

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Weight-Volumetric Proportioning of Concrete Aggregates in Testing*

By J. A. KITTS†

Error in Volumetric-Proportioning. Various methods have been devised for measuring volumes of cement, sand, and rock. One difficulty encountered in making a purely volumetric measurement of these materials is to place them in the vessel in such a manner that a uniform degree of compactness will obtain in each measurement. Another is due to the irregularity of the surface of the materials. In measuring a given volume the accuracy depends, necessarily, upon a single measurement. We may, however, determine the volume of a certain mass of material accurately by making several measurements. If several determinations are made of the specific gravity and percentages of voids, and means are taken to obtain the full range of compactness in determining the percentage of voids, we may obtain a reliable figure for the apparent specific gravity of the material for average compactness. We may then weigh out volumes of the material with uniformity, and will have before us both weight and volumetric proportions, the volumetric proportions being the essential information.

Variability of Volume in Weight-Proportioning. From elementary principles we have:

$$\text{Volume} = \text{weight} \div \text{specific gravity.}$$

We are not, however, dealing with actual volumes, in the case of cement, rock, and sand, but with apparent volumes:

Apparent volume = weight ÷ apparent specific gravity, and
Apparent specific gravity = (unit volume − voids) specific gravity, or
Apparent volume = weight ÷ (unit volume − voids) specific gravity.

It is evident, therefore, that the apparent volume per unit of weight decreases as the specific gravity increases, and that it increases as the voids increase. Table I shows the variations of the volumetric proportions of various sands in sand-cement mortars of normal consistency and of 1:3 proportions by weight; also the ratio of volume of cement-paste to volume of voids in each case.

TABLE I.—VARIATIONS OF VOLUMETRIC PROPORTIONS IN 1:3 WEIGHT PROPORTIONING

Sand No.	Specific gravity	Voids %	Apparent specific gravity	Weight proportions Cement: Sand	Volumetric proportions Cement: Sand	Ratio of cement paste to voids
1a	2.65	37.0	1.67	1 : 3	1 : 3.18	0.85
2	2.74	35.2	1.78	1 : 3	1 : 2.97	0.95
3	2.63	39.8	1.58	1 : 3	1 : 3.34	0.75
4	2.78	36.6	1.76	1 : 3	1 : 3	0.91
5	2.77	27.9	2.00	1 : 3	1 : 2.64	1.36

a Standard Ottawa sand.

Assuming that 110 lb. of cement make 1 cu. ft. of cement-paste of normal consistency, the apparent specific gravity cement is 1.76; and the volumetric proportions as indicated in Table I, are determined as follows:

$$\frac{\text{Apparent volume sand}}{\text{Apparent volume cement}} = \frac{3 \times \text{Apparent specific gravity cement}}{\text{Apparent specific gravity sand}} = \frac{5.28}{\text{Apparent specific gravity sand}}$$

Is there any justification for comparing these sands in mixtures in which the proportions of voids filled with cement vary from 75 to 136%? If it is desired to determine the relative strengths of sands per unit measure of cement, the volumes of sand should be equal. We are not so much concerned, however, with the strength of mixtures of equal volumetric proportions as we are with the comparative costs per unit of strength of the most economical mixtures with the various sands. In general, the minimum cost per unit of strength will obtain when the volume of cement-paste is equal to that of the voids. The weights and volumetric proportions of these sands for the ratio, volume of cement paste ÷ volume of voids = unity, will be indicated hereafter under the title 'Comparative Tests of Sands.'

Weight-Volumetric Proportioning. If we wish to weigh out certain volumes of sand and cement for cement-sand mortar, with the object of using a certain volume of cement-paste with a unit volume of sand, then:

$$\frac{\text{Weight of cement}}{\text{Unit weight of sand}} = \frac{\text{Apparent specific gravity cement} \times \text{proportion of paste}}{\text{Apparent specific gravity sand}}$$

EXAMPLE: To use 0.37 parts by volume of cement-paste of normal consistency with one part by volume of standard Ottawa sand, the part of cement by weight is (1.76 ÷ 1.67) 0.37 = 0.390. The weight proportions then are 1 sand:0.39 cement, corresponding to volumetric proportions of 1 sand:0.37 cement, or 1 cement:2.7 sand.

The writer finds it desirable to use sand as the unit of measure, when considering a mortar, as in any stated volumetric proportions the ratio of volume of cement-paste to volume of voids in the sand may be estimated at a glance. It will be observed in the above example that the volume of paste is equal to the proportion of voids in the sand. Weight-volumetric proportioning of concrete aggregates may be made in a similar manner, as will be indicated below under 'Progressive Proportioning of Concrete Aggregates.'

Comparative Tests of Sands. In making comparative tests of sands we should have like conditions in every case. If we have the same proportions by weight, or by volume, the ratio of volume of cement-paste to volume of voids is different in every case. One mixture

*Paper presented before the American Society for Testing Materials, June 1915.

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may be porous from too little cement while another may be dense but may have the sand particles widely separated by too much cement. For like conditions, the consistency of the mixtures should be the same and the volume of cement-paste should be equal to the volume of voids. The weight and volumetric proportions of sands No. 1 to 5 for comparative tests should be as shown in Table II for mortars that are of normal consistency.

It may be considered advisable to use an excess of paste in each case, for example, 105% of the voids in the sands. The equation in this case would be written as follows:

$$\frac{\text{Weight of cement}}{\text{Unit weight of sand}} = \frac{1.05 \text{ apparent specific gravity cement} \times \text{voids in sand}}{\text{Apparent specific gravity sand}}$$

The strength, or the cost per unit of strength, will indicate the most satisfactory sand to be used in a given case.

TABLE II.—VOLUME OF CEMENT PASTE = VOLUME OF VOIDS

Sand No.	Specific gravity	Voids %	Apparent specific gravity	Volumetric proportions Sand : Cement	Weight proportions Sand : Cement	Ratio of cement paste to voids
1....	2.65	37.0	1.67	1 : 0.370	1 : 0.390	1
2....	2.74	35.2	1.78	1 : 0.352	1 : 0.348	1
3....	2.63	39.8	1.58	1 : 0.398	1 : 0.443	1
4....	2.78	36.6	1.76	1 : 0.366	1 : 0.366	1
5....	2.77	27.9	2.00	1 : 0.279	1 : 0.246	1

$$\frac{\text{Weight of cement}}{\text{Unit weight of sand}} = \frac{\text{Apparent specific gravity cement} \times \text{proportion of paste}}{\text{Apparent specific gravity sand}}$$

Progressive Proportioning of Sand-Cement Mortar. In making a study of a given sand it is advisable that the mortar be made of the same consistency as that to be used in the field. The most satisfactory consistency for general use is the initial flowing consistency. Approximately 94 lb. of cement makes one cubic foot of cement paste of this consistency and the apparent specific gravity for this consistency is 1.5. This is the initial degree of wetness that will cause the cement-paste to flow, as a liquid, from a plane inclined at 45 degrees. The amount of water necessary to make a paste of this consistency may be taken approximately as follows:

34% of water by weight of dry cement.
39% of water by volume of dry cement.
50% of water by volume of resulting paste.

With this high percentage of water, necessary in the field, it will be recognized that the strength of a mortar of normal consistency is not representative of that of a mortar of the consistency under working conditions.

In order to determine the mortar of maximum density and also the mortar giving satisfactory strength, the progressive proportions in Table III are suggested, as preferable to the usual proportions, for sand No. 1 in a mortar of initial flowing-consistency as above described.

TABLE III.—PROGRESSIVE PROPORTIONS FOR CONSISTENCY UNDER WORKING CONDITIONS

Cement-paste %	Proportions by volume Sand : Cement-paste	Ratio of cement-paste to voids	Proportions by weight[1] Sand : Cement
20	1 : 0.20	0.54	1 : 0.18
25	1 : 0.25	0.67	1 : 0.225
33.3	1 : 0.333	0.90	1 : 0.30
37a	1 : 0.37	1.00	1 : 0.333
40	1 : 0.40	1.08	1 : 0.36
50	1 : 0.50	1.35	1 : 0.45
66.7	1 : 0.667	1.80	1 : 0.60
100	1 : 1.00	2.71	1 : 0.90

a Volume of cement paste equal to volume of voids in sand.

[1] $\frac{\text{Weight of cement}}{\text{Unit weight of sand}} = \frac{1.5 \times \text{volume of paste}}{1.67} = 0.9 \times \text{volume of paste.}$

The mortar of maximum density may be determined by weighing the test specimens.

Progressive Proportioning of Concrete Aggregates. Having determined the mortar of maximum density and satisfactory strength, progressive proportions of the mortar with the rock may be made in a similar manner as cement with sand.

An amount of rock equal to the volume of the test-cylinder should be used for each test-specimen.

The progressive proportions in Table IV are suggested for the following grades of cement, sand, and stone:

Material	Specific gravity	Per cent of voids	Apparent specific gravity
Cement	3.1	51	1.5
Sand No. 1.....	2.65	37	1.67
Rock	2.50	43.65	1.41

Test cylinder: diameter, 8 in.; length, 16 in.; volume, 13.1793 litres.

Weight of rock to fill cylinder: $1.41 \times 13.1793 = 18.583$ kilograms.

TABLE IV.—PROGRESSIVE PROPORTIONS OF MORTAR WITH ROCK

Weight rock kilograms	Ratio of mortar to voids	Mortar of 'work' consistency %	Volume liters	Weight of sand,[1] kg.	Weight of cement,[2] kg.	Volumetric proportions
18.583	0.80	35	4.673	7.804	2.593	1 : 2.7 : 7.7
"	0.92	40	5.272	8.871	2.926	1 : 2.7 : 6.8
"	1.00a	43.65	5.753	9.575	3.193	1 : 2.7 : 6.2
"	1.05	45	5.930	9.937	3.291	1 : 2.7 : 6.0
"	1.15	50	6.589	11.004	3.657	1 : 2.7 : 5.4

a Volume of mortar equal to volume of voids in rock.

[1] Weight of sand = $\frac{\text{Volume of mortar} \times \text{apparent specific gravity of sand}}{\text{Yield of mortar}}$

[2] Weight of cement = $\frac{\text{Volume of mortar} \times \text{voids in sand} \times \text{apparent specific gravity of cement}}{\text{Yield of mortar}}$

The yield of mortar for sand No. 1 and 37% cement-paste, as used in Table IV, is assumed as unity. The weight of the test-specimens will indicate the mixture of maximum density. Permeability-specimens may be made in the same proportions and tested in whatever manner desired.

Conclusions. By this method of weight-volumetric proportioning we may obtain a fairly accurate knowledge of the action of various combinations of materials in mortars or concretes, and the results, instead of being freaky, will be consistent to a degree not attainable by

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simple volumetric or simple weight-proportioning. The advantages of this method are:

1. That volumes may be weighed with ease and accuracy.

2. That the proportions may be found with regard to the superficial volume, actual volume, or the volume of voids of the materials.

3. That the error of volumetric measurement due to variability of compactness and irregularity of surface is eliminated.

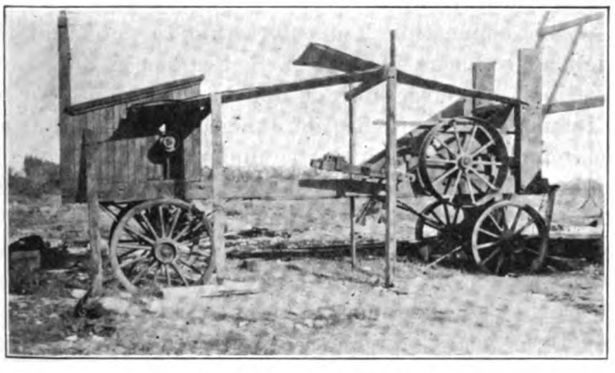
4. That the voids in sand may be accurately filled with cement paste and the voids in rock with cement-sand mortar.

A porous mortar or a porous concrete is not an economical mixture with reference to cost per unit of strength. A mortar with cement greatly in excess of the volume of voids in the sand is not an economical mixture. A concrete with mortar greatly in excess of the volume of voids in the rock is not an economical mixture. The vital changes in density, permeability, and cost per unit of strength take place by variations in the volume of the filling medium when this volume is in the vicinity of that of the voids. In progressive proportioning of mortars or concretes we may investigate a wide range of proportions including that in which the voids in the materials are filled; or, we may investigate a limited range in the vicinity of the voids, by means of the methods proposed, and thus determine the most economical proportions for mortar or concrete accurately and scientifically.

A Portable Electric-Hoist For Water-Supply Works

By F. E. TRASK*

Having often been requested to publish data relative to the method of maintenance and operation of water-supply works, I take this opportunity to describe a portable electric-hoist which is a valuable part of the equipment of several of the water-works and irrigation companies among my clients on this coast. Probably 60% of the water supply in this section of the state is procured from underground sources by means of wells and pumps of one kind or another. Many corporations are drawing water from twenty or more wells, necessitating a considerable expenditure for labor in sand-pumping wells, the replacement of worn parts of pumps and their adjustment to meet the various elevations of ground-waters. The accompanying photograph shows a portable electric-hoist that is in almost constant use by the San Antonio Water Co., of Ontario, California, being designed by superintendent Manley to meet various demands of his work. The hoist is composed of the following: a two-horse farm-wagon running-gear, upon which a 3 by 10-in. Oregon pine wagon-frame has been securely bolted. The housing over the rear wheels contains an induction-motor with accessories, and sufficient additional space for a belt and necessary tools. A standard two-ton hoist, belted to the induction-motor, is placed immediately back of the front axle. As shown in the photograph, this hoist is in place, at one of the company's wells, its motor wired to the power-line and its hoist-cable passing over the well tower, ready to be used in removing the pump when the belt is connected. By bolting an 'A-frame' to the two uprights, near the front axle, and placing a detachable boom, the hoist may be used as a portable derrick with a swinging radius of ten or twelve feet.



PORTABLE ELECTRIC-HOIST.

This hoist has been used with economy for the following purposes; hoisting tunnel-waste and lowering pipe and concrete for lining tunnels; hoisting large rock from pipe-line trenches and lowering pipe to place; moving earth by the drag-line scraper method; sand-pumping of wells; setting pumps, pipe, and machinery at pumping-plants; loading and unloading cars; setting and replacing poles and towers; and performing many other minor operations incident to water-supply management.

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The deepest well in the world is in Upper Silesia, in the German Empire. It is a diamond-drill hole in a coalfield and is 7350 ft. deep. A well in the United States which may go deeper, according to the United States Geological Survey, is 4 miles northwest of McDonald, Pennsylvania, and about 15 miles west of Pittsburg. This well, which is being sunk to the Medina sandstone, is now 7174 ft. deep. Some gas and oil were struck in the upper part of the well. Between the depths of 6830 and 7100 ft. rocks bearing rock-salt and salt water were encountered. The temperature in this well at the depth of 6775 ft., as recently determined with great accuracy, is 145.8°F. At Derrick City, McKean county, Pennsylvania, near Bradford, there is a well 5820 ft. deep, which is probably the second deepest well in the United States. Another well, on Slaughter creek, Kanawha county, West Virginia, is 5595 ft. deep. It penetrated a sandstone at 5030 to 5050 ft., and from this point to the bottom the well is in limestone. Near West Elizabeth, Pennsylvania, there is another well 5575 ft. deep, penetrating into a black shale.

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Construction and Maintenance of Earth Roads in Arid Districts

By H. A. INGALLS*

We have in Kern County and California generally, excellent materials and favorable conditions for good roads and we are spending money enough to have good roads everywhere if intelligently expended. In this article I will confine myself to the construction of earth-roads without oil or other foreign material. While improved roads are all very well, the fact remains that most of the roads in the country must always be earth roads. Intelligent construction and maintenance of earth roads will result in the greatest good to the greatest number. This last winter we graded and repaired a dirt road 20 miles long over adobe, alkali, and sandy stretches at a total expense of $350. This will constitute the upkeep for one year. The road was full of chuck-holes in December with water standing in pools. Many of the holes had to be filled with fresno scrapers. Nevertheless the road is now in fair condition as a result of our treatment. The graded portion was widened and shaped so that a king grader can be worked to advantage. Next year the cost of maintenance should be about $10 per mile and the holes will be puddled and packed so that the entire road bed will be hard. We do not move any more material than is necessary to fill the chuck-holes and make them easy to travel over, and even this is done during wet weather only or else immediately after a rain. We fill the uneven places gradually and have them packed from the bottom up, at the same time smoothing the entire roadbed. This is better than tearing up the roadbed and bringing it to some sort of grade all at once. In other words we never disturb an old roadbed except to make the poor places better. We never fill holes when full of water if it can be avoided, but drain them to the side if possible. We then go ahead and smooth the road with a grader, gradually getting the centre high enough to run the water off and at the same time filling the holes. We use a king grader or something similar. They shape the surface like a jack-plane cutting the earth and carrying it toward the centre, at the same time filling the holes. The blades being adjustable are easily controlled. One of the most important points about maintaining an earth road in this country during the long dry season, is to make the smooth roadbed wide enough, so that the traffic can avoid chuck-holes and patches of dust when these appear. If this is done, the chuck-holes remain comparatively small, and an easy-riding road is the result.

We find that there is not much dust when a road is treated in this way, neither are there holes and ruts to retain water and ruin the road in winter. By following these rules a road may be obtained at small expense that will be in fair condition throughout the year, no matter what the weather conditions.

*Bakersfield, California.

Fuel-Oil for Ocean-Going Vessels

By CHESTER W. WASHBURNE*

There should be an opening for fuel oil in every coaling station in the world, and every vessel engaged on long voyages, as between Europe and South America or South Africa should be fitted to burn oil. There may be some doubt about the economy of the transformation for vessels bound to the east coast of South America, where coal is carried practically as ballast on the return trip of vessels that carry wheat and other staples to Europe. In Africa, however, the tonnage, excluding coal, exceeds the tonnage of exports, hence high freights must be paid on coal from Wales. The same is true of the Australian coals that dominate the market on the east coast of Africa, which furnishes practically no return cargo to Australia. The South African coals are poor and dirty. They are economical for the local railroads, but not for steamships, which require stocks of admiralty-grade coals even at Beira and Durban, the principal ports of the African coal mines. As a result the steamers have to pay 45 to 70 shillings per ton for such coal in time of peace. At present the price exceeds 120 shillings ($30) per ton at some ports. There has been no doubt expressed about the wisdom of the United Fruit Company in transforming its Caribbean fleet to burn oil, but some doubt has been expressed about the same action proposed for the Royal Mail steamers from Southampton to South America. If the latter venture is tried and proves successful, there is no doubt in my mind that it will be even more profitable in South Africa.

In this connection it is interesting to note that the English producers in Mexico, S. Pearson & Son, Ltd., have installed large storage and loading-plants for oil at Buenos Aires and Rio de Janeiro, as well as at all the important English ports, under the name of the Anglo Mexican Petroleum Products Company. Organized as the Eagle Oil Transport Company, they have built 19 large tank steamers, which include the ten largest tankers in the world, and which have increased the world's total tonnage of tank-steamers by 20% in only three years. If one English company can create markets for fuel oil at this rate, does it not look as though the California companies were asleep?

From their activity in getting control in California you must realize that the English do not intend to lose their grip on the world's commerce that would be endangered by American control of fuel oil. To any observer of their activity throughout the world this fact is unfortunately convincing. The imminent transfer of ocean steamers from coal to oil has caught America napping in a splendid opportunity. Admiral Evans has shown† that there are practically no American tankers on the Atlantic sea-board which could be used by the navy in time of war and that the lack of transport facilities greatly weakens our commercial

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†Bull. Am. Inst. Min. Eng., September 1914, p. 2293.

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and naval standing. From every standpoint, including the profitable development of our oil-fields as well as commercial prestige and patriotism, there is an urgent call for American business men to wake up to an opportunity that will soon be beyond their reach, to build an adequate fleet of tank-ships, and to go after the markets of the world. These markets do not exist until they are made. Shall we let England do all the making and reap all the profits? Rest assured that she is doing it, even at present, in the face of tremendous odds in our favor.

TERNE PLATES AS A SUBSTITUTE FOR GALVANIZED IRON

The War has increased the amount of zinc exported from the United States from 4,000,000 lb. per year to 17,683,173 lb. in the month of April last. This increased consumption has stimulated the demand for substitutes for galvanized iron. Terne plates, or ordinary roofing tin, have been in use for many years. They consist of sheet iron, coated with a mixture of tin and lead. The principal use of the tin is to make the mixture adhere to the sheet-iron. Authorities differ as to the proportion of tin used, placing it anywhere from 10 to 33⅓%. It is probable that manufacturers, from motives of economy, use as little tin as possible.

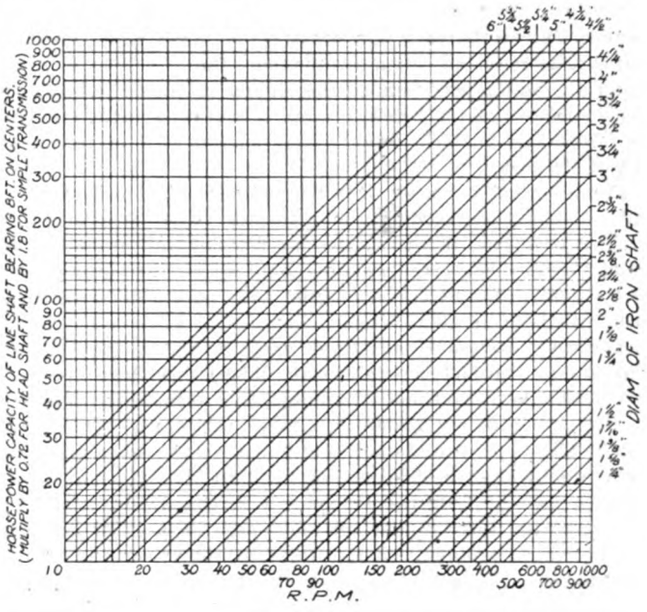
The amount of coating used ranges from 8 to 40 lb. per box of 112 twenty by twenty-eight inch sheets. As a box contains 800 sq. ft., it is evident that an 8-lb. coating would afford but little protection. The cost of terne plates with the heavier coatings is more nearly that of galvanized iron. On account of the general uncertainty of the metal market, comparative prices have but little significance. Lead-coated sheets are better than galvanized iron where there are acid fumes. One manufacturing company claims to have discovered a process that renders the use of tin unnecessary.

A flat concrete arch of long span was built during the past year over the Aare river at Olten, Switzerland. Its span is 269 ft. and its rise 30.4 ft., giving a ratio of span to rise of 8.8. The bridge is relatively narrow, being only 26 ft. wide between railings. The 16-ft. roadway is designed for 77 lb. per sq. ft. and a wagon of 13 tons weight, while the sidewalks are figured for 110 lb. per square foot. The arch is three-hinged. Its curve was laid out to follow the pressure line. The width of barrel is 19.7 ft.; the ring thickness is 62-in. at the quarter points, 48 in. at the crown, and 52 in. at the skewbacks. The maximum stress in the concrete is somewhat less than 700 lb. per sq. in. The roadway, a 6-in. slab, is carried by four stringers supported directly on columns resting on the arch. The slab extends beyond the outer line of stringers to form the sidewalks. Expansion joints in the roadway are provided over the springing-line and at the point where the roadway merges with the arch-barrel. Load tests under a 16-ton steam-roller gave deflection of ⅛ in.—*Engineering News.*

Engineers' Note Book

DIAGRAM FOR COMPUTING HORSE-POWER TRANSMITTED BY SHAFTING AND BY COTTON ROPE

By the use of the first diagram the safe horse-power for line-shafting may be read direct. For head-shafting, multiply this result by 0.72. For simple transmission, where power is not


HORSEPOWER CAPACITY OF LINE SHAFT BEARING 8FT. ON CENTERS. (MULTIPLY BY 0.72 FOR HEAD SHAFT AND BY 1.8 FOR SIMPLE TRANSMISSION)
DIAM. OF IRON SHAFT
R.P.M.

DATA OF COTTON DRIVING ROPES

DIAM, IN.	WT. PER FT. LB.	BREAKING STRENGTH, LB.	SAFE LOAD LB.	DIAM. OF SMALLEST PULLEY, IN.	CENTER TO CENTER OF ROPES, IN.
¾	0.15	2,600	106	22	1⅛
⅞	0.20	3,500	144	26	1¼
1	0.26	4,600	190	30	1½
1¼	0.40	7,200	294	37	1¾
1½	0.58	10,400	426	45	2⅛
1¾	0.79	14,000	576	52	2¼
2	1.04	18,400	750	60	2¾

WEIGHT PER FT. = 0.8T x DIAM.² BREAKING STRENGTH = 4600 x DIAM.²
WORKING LOAD = 160 x DIAM.² SMALLEST WHEEL = 30 x DIAM.

HORSEPOWER OF COTTON ROPES

VELOCITY IN FT. PER MIN.	DIAM. OF ROPE, IN.						
	¾	⅞	1	1¼	1½	1¾	2
1,000	3.16	4.30	5.67	8.76	12.7	17.2	22.3
1,200	3.77	5.12	6.76	10.4	15.1	20.5	26.6
1,400	4.36	5.93	7.83	12.1	17.6	23.7	30.8
1,600	4.94	6.74	8.86	13.7	19.9	26.9	34.9
1,800	5.50	7.47	9.86	15.3	22.1	29.9	38.9
2,000	6.03	8.20	10.8	16.7	24.3	32.8	42.6
2,200	6.55	8.90	11.8	18.2	26.4	35.6	46.3
2,400	7.04	9.56	12.6	19.5	28.3	38.3	49.7
2,600	7.50	10.2	13.4	20.8	30.1	40.7	53.0
2,800	7.92	10.8	14.2	21.9	31.8	43.0	55.9
3,000	8.31	11.3	14.9	23.0	33.4	45.2	58.7
3,200	8.69	11.8	15.6	24.1	35.0	47.2	61.4
3,400	9.01	12.2	16.2	25.0	36.2	48.9	63.6
3,600	9.29	12.6	16.7	25.8	37.4	50.5	65.7
3,800	9.53	13.0	17.1	26.4	38.4	51.8	67.4
4,000	9.75	13.2	17.5	27.0	39.2	53.0	68.9
4,200	9.91	13.5	17.8	27.5	39.8	53.8	70.0
4,400	10.0	13.6	18.0	27.8	40.3	54.4	70.7
4,600	10.0	13.7	18.0	27.9	40.4	54.6	71.0
4,800	10.1	13.7	18.0	27.9	40.5	54.7	71.1
5,000	10.0	13.6	17.9	27.7	40.2	54.4	70.7
5,200	9.9	13.5	17.8	27.5	40.0	54.0	70.0
5,400	9.8	13.2	17.4	27.0	39.5	53.0	69.0

taken at intervals along the shaft, multiply by 1.8. In using the second diagram, it is well to remember that the economical range of speed is between 4000 and 5400 ft. per minute and that the best results are obtained with speeds around 4800 ft. per minute.

A simple way to compute the velocity in feet per minute is to multiply the diameter of the sheave by 22/7, and the product by the number of revolutions per minute. The values given in the table are in terms of horse-power per rope.

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Hints on Practice

THE USE OF THE SIPHON ON CONSTRUCTION-WORK

It often happens on steam-shovel or other construction work that it is necessary to raise water to a considerable height. At sea-level, a perfect vacuum could be used to raise water to a height of 34 ft. No siphon has ever been made, however, which will produce a perfect vacuum. An ordinary first-class siphon will lift water from 22 to 25 ft. by suction if the piping connections are perfect. On construction work, however, it is not safe to count on raising water more than 15 ft. by suction. After the water once gets to the siphon it can be raised to a considerably greater height. With a first-class siphon it can be forced 75 ft., which with 25 ft. of suction pipe gives a total lift of 100 feet.

For practical purposes on construction-work, however, it is safe to count on forcing the water 30 to 40 ft. above the siphon, or say 50 ft. in all. In order to operate properly, the suction-piping below the siphon should not contain over one or two elbows. A single run of pipe with no elbows or fittings whatever is preferable. The discharge-pipe, on the other hand, can contain several connections without making the siphon unreliable. In fact, a slight leak in the discharge-pipe will not hinder its operation. The only valve absolutely necessary in the piping lay-out is one to regulate the steam. This valve can be placed next to the boiler of the steam-shovel or drag-line excavator, where the firemen can regulate it. It is not necessary to have it near the siphon. A screened box should be placed at the inlet of the suction pipe. To prevent possible trouble there should be a foot-valve at the lower end of the suction-pipe. This prevents the water from draining out of the piping every time the siphon is stopped. This foot-valve is almost a necessity if the siphon is placed over 10 ft. above the level of the water. In general it may be said that a siphon is of the same general class of machinery as an injector and the following rules hold good for both.

1. The suction pipe must be as short and straight as possible.
2. The siphon or injector should be placed as close as possible to the level of the water supply.
3. The suction piping should be absolutely tight.
4. There should be a check-valve in the line. With an injector, the check-valve is placed in the discharge line between injector and boiler. With a siphon, the check-valve is placed under water at the inlet to the suction-pipe, and is not necessary for low lifts.—*Excavating Engineer.*

Industrial Progress

EXHIBIT OF AMERICAN WELL WORKS AT THE PANAMA-PACIFIC EXPOSITION

In the exhibit of the American Well Works of Aurora, Ill., situated in the Palace of Machinery, a complete line of well-drilling and well-pumping machinery is shown. At the entrance there is a miniature derrick. On the left there is a two-stage centrifugal pump with a governing device encased in a vacuum chamber. The pump is direct connected to an electric motor by means of a flexible coupling. This coupling allows the armature shaft to attain an endwise motion and thus to start slightly ahead of the pump itself, thus reducing the strain due to a load suddenly being brought upon the motor in starting. The cover of the pump is lifted to allow an inspection of the mechanism. On the opposite side a single-stage centrifugal pump is shown, also direct-connected to an electric motor, and with a capacity of 2200 gallons per minute against a 125-ft. head. There is also shown a special centrifugal pump designed for pumping sandy water, which is intended for use on suction dredges.

Among the deep-well machinery, there is a large turbine pump mounted with the tubing and pumping head. There is also a large two-stroke deep-well pump of the piston type, mounted complete with an electric motor. A small pump of the same type is connected to an electric motor and to a tank in such a manner that the pump may be started and water pumped from the tank precisely as from a well. Several working barrels, designed for use with single-acting direct-lift pumps are shown separately. Some of these are triple acting and some quadruple acting, an innovation, we believe, in pump design. There are several smaller pumps, both deep-well and centrifugal, included in the exhibit.

In the line of drilling apparatus, a complete rotary outfit, including rotary table, draw-works, etc., is shown. In connection with this there is a core of hard rock, 24 in. in diameter, which was obtained while drilling a well with one of these rotary outfits using adamantine.

EXHIBIT OF THE PITTSBURGH-DES MOINES STEEL COMPANY AT THE PANAMA-PACIFIC EXPOSITION

The principal feature of the exhibit of the Pittsburgh-Des Moines Steel Company in the Palace of Machinery at the Panama-Pacific Exposition, is a half-section of a standard 50,000-gallon water-tower. The structure is 40 ft. high and 19 ft. in diameter. All the necessary accessories are shown and there are stairways and platforms so that they may be easily examined. The tower rests on a concrete foundation. While the supporting columns are necessarily short, the connections both to the piers and to the tank itself are shown. One-fourth of the horizontal balcony which is placed near the base of the tank to resist the thrust from the posts is shown. The tank has a hemispherical bottom formed of steel plates dished when cold to the exact curvature. The various ladders for reaching any part of the inside or outside of the tank are shown in place.

Details of both railroad-tanks and tanks for municipal supply are shown. The railroad-tanks have towers short enough to allow vertical posts to be used and no balcony, while tanks for municipal supply usually have to be placed high enough to require inclined posts and a balcony to resist the resultant thrust. Other details for tanks shown in the exhibit include two kinds of gauges for showing the depth of water in the tank, and a circulating heater for use in cold climates. In another part of the exhibit there is a large scale map of the United States containing over one thousand pins, each pin marking the position of a tank erected by the company.

THE DEAN RIVER CURRENT DEFLECTOR

One of the most important problems of river-control is that of protecting the banks of a stream against the scouring action of the current. In seasons of flood, levees and other forms of bank protection are frequently undermined, and much valuable property destroyed. The most effective way of combatting this difficulty would seem to be to devise some way to make use of the transporting power of the river itself to strengthen the exposed portions of the river-bank. The Dean River Current Deflector, represented in the west by the River Control Company, of San Francisco, is designed with this purpose in view.

One of these deflectors, which was recently placed on the Gila river, in Arizona, is shown in the accompanying photograph. The Deflector is V-shaped with the point extending into the river. As a rule it is built about eighteen feet long, eight feet high at the point, and four feet at the rear. It is constructed of 2 by 8-in. timber for sheeting and 4 by 6-in. stringers. The whole structure is anchored to the bank with

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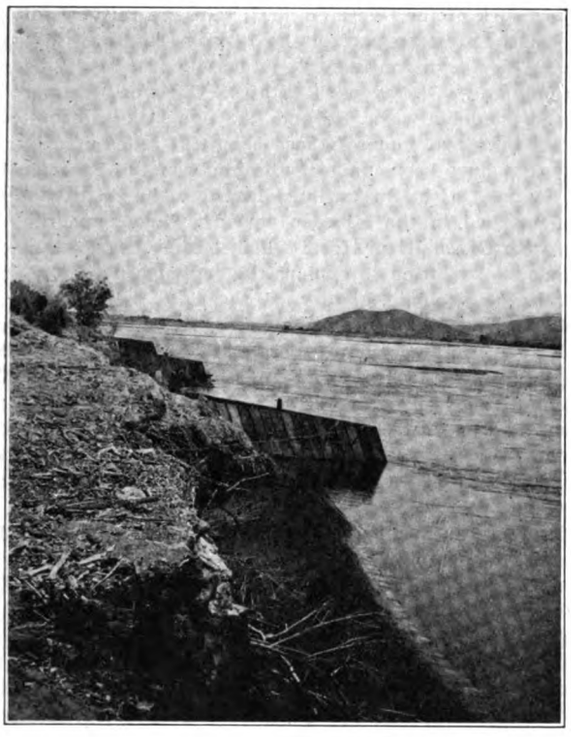
eight ½-in. cables attached to concrete deadmen weighing one or two tons each, which are buried securely in the bank. The Deflector is arranged so that a certain amount of water passes under the device and rises immediately on the downstream side. This meets the current coming around the point of the Deflector and against the bank and tends toward slackwater conditions and the deposition of material, thereby strengthening the bank as well as preventing further scouring and undermining.

To accomplish this purpose, the Deflector must be placed so that the main current does not strike it perpendicularly, but at an angle which depends largely upon the velocity of the



THE DEAN DEFLECTOR.

current. The correct placing of the device is a matter which calls for a considerable amount of engineering skill and judgment. If the Deflector is not carefully placed it may do more harm than good. Some difficulty has been experienced from the change in current conditions at different stages of a stream. This has sometimes been met by placing additional deflectors, and sometimes by other methods. As most of the scouring action occurs during high-water periods it is usually unnecessary to provide for any other stage of a stream. The device can be placed during the high-water period, but this adds considerably to the cost. In addition, the Deflectors have to be re-set after the flood stage has passed which also increases the expense.

The amount of bank protected by one Deflector varies from 75 to 300 ft., depending upon the curvature of the river. At the point shown in the photograph, three Deflectors protect 1200 ft. of bank, but this is an exceptional case. In some cases one Deflector is sufficient to protect the bank, but more often from two to six are necessary, according to the distance to be protected. The cost of the Deflectors, including labor, material, and patent rights, will range from $250 to $350 according to local conditions.

Besides being used for bank and levee protection, the Deflector is of value in protecting other structures, such as dams, bulkheads, trestles, etc., from the scouring action of rivers.

Deflectors have been placed on a number of streams with satisfactory results, including a considerable saving over other methods of bank-protection.

EXHIBIT OF THE LAGONDA MANUFACTURING CO. AT THE PANAMA-PACIFIC EXPOSITION

Among the interesting exhibits at the Panama-Pacific Exposition is that of the Lagonda Manufacturing Co., of Springfield, Ohio, represented on the Pacific Coast by Chas. C. Moore & Co. It consists mainly of boiler-tube cleaners, automatic cut-off valves, multiple strainers, and grease extractors.

On entering the exhibit, the visitor sees on the left the high-power direct motor-driven tube-cleaners for boilers, condensers and economizers, suspended and inserted in condenser tubes and the tubes of a Babcock & Wilcox manifold, just as they are in actual use. Directly behind these cleaners can be seen the hand-wheels of the outside and internal dashpot automatic cut-off valves, types A and B and the internal dashpot non-return valve, type C. At the rear and to the extreme left a Stirling-boiler cleaning-device is shown. With this device the entire operation of cleaning is performed from without the drum. The device is supported in an oval frame, representing the manhole, and has the cleaner and the rubber operating hose inserted, just as in actual use. Immediately to the right are shown the electric, air, or steam-driven reseating machines, for reseating and grinding machined-surfaces and for cleaning scale and soot from caps and nuts of Babcock & Wilcox and similar boilers. At the entrance of the exhibit, there is a display of several types of water, air, and steam-driven cleaners for water and fire-tube boilers, condensers, and other tubular apparatus, also cleaners for curved-tube boilers. An extractor for removing deposits of oil and grease from boiler-feed water is also shown in this exhibit, as well as other boiler-room specialties.

Behind the cleaners are shown tube-cutters. There is also a sectional model of the type A automatic cut-off valve, showing the construction and operation of the valve and the external dashpot. Directly behind this is a grease-extractor and a three-basket multiple strainer. A three-basket strainer has been constructed with a glass panel at one end, so that the flow of water through the strainer and the accumulation of solid matter in the basket can be seen. All the solid matter passing into the strainer is caught in the baskets. The baskets can be individually drawn out of commission, removed, and cleaned without interrupting the operation of the other baskets or the flow of water.

THE PNEUMERCATOR

There are many devices for reading the depth of liquid in tanks or other vessels when the observer is at some point distant from the tank. Most of these devices depend in one way or another upon the transferrence of variations of pressure in the tank by means of a tube containing compressed air to a mercury gauge. A long tube is usually necessary and leakage of air at the connections frequently destroys entirely the accuracy of the readings. To obviate this difficulty an instrument called the Pneumercator has been designed by the Pneumercator Company of New York. While the Pneumercator was originally designed to measure the draft of ships, another design for measuring liquids in tanks both on shipboard and on land has also come into use. Both types, the D-1 for use on shipboard, and the T-1 for tanks and reservoirs are shown complete at the Company's exhibit in the Palace of Machinery at the Panama-Pacific International Exposition, in charge of the Company's Pacific Coast representative James C. H. Ferguson.

The device consists of a balance-chamber, pipe-line, pressure-gauge, and control-valve. The balance-chamber is placed on the bottom of the tank and securely attached so that the orifice is at some pre-determined point, which point should be the zero of the gauge. The pipe-line is then led to the place where the reading of the contents of the tank is desired to be taken and connected to the control-valve of the gauge. The source of

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compressed air is then connected to the control-valve and the instrument is ready to be placed in operation as soon as the liquid in the tank rises sufficiently to cover the orifice in the balance-chamber. The control-valve may be placed in four positions. In the first, connection is made between the balance-chamber and the air-pump; in the second between the balance-chamber and the gauge. In the third position the gauge can be returned to zero without losing the pressure existing between the balance-chamber and the gauge. In the fourth position all connections are closed.

Setting the control-valve so that the balance-chamber and the gauge are connected, the liquid rises and flows into the orifice in the balance-chamber until the resulting head compresses the air in the pipe-line so that one balances the other. The point at which this balance takes place varies with the length of the connecting pipe-line, and consequently the accuracy of the reading of the gauge cannot be depended upon unless the point of balance takes place exactly at the orifice, as the gauge will show an error proportionate to the distance at which the liquid in the balance-chamber stands above the orifice.

If, however, the level in the balance-chamber where the air and liquid meet is established at the orifice, the mercury in the gauge will indicate the true depth of the liquid in the tank above the orifice. Therefore, accurately to set the gauge, the control-valve is placed to connect the balance-chamber and the pump. The small hand-pump is used to force air through the pipe-line to the balance-chamber at a pressure in excess of that created by the head of liquid in the tank, thereby expelling whatever liquid may be in the balance-chamber above the orifice. The control-valve is then placed so as to close all connections. Any excess of air-pressure in the pipe-line greater than the head of the liquid escapes through the liquid, and the air-pressure in the pipe-line and the balance-chamber exactly balances the head of the liquid at the orifice.

The control-valve is again placed so as to connect the balance-chamber and gauge. The air in the pipe-line exerts its pressure on the mercury so that the latter rises to a height sufficient to balance the air-pressure, thus indicating the exact depth of the liquid in the tank above the orifice or zero-point. As the tank is filled the mercury continues to rise in direct ratio to the head of the liquid. The system can be 'blown out' at any time and the accuracy of the zero reading tested, this being the distinctive feature of the Pneumercator as compared with other similar devices.

Book Reviews

THE OVERLAND ROUTE: A GUIDEBOOK OF THE WESTERN UNITED STATES. Bulletin 612. U. S. Geological Survey. Ill. P. 244. Price, $1.

This is one of four books to be issued by the Geological Survey with a view to giving scientific information to travelers on the transcontinental lines of railroad. They are based on the data contained in previous geological reports, plus unpublished information, supplemented by a special field-examination by officers of the Survey. The present volume is credited chiefly to Messrs. Willis T. Lee, Ralph W. Stone, and Hoyt S. Gale. No less than 29 accurate maps are interleaved, besides numerous photographs, geological sections, and sketches. The foot-notes are so absorbing that the reader lingers on his way, as at one of those Harvey "eating houses" (what a term!), or railroad-hotels, that used to cheer the traveler in the days before the pretentious Pullman 'diner' came into use. From Council Bluffs to San Francisco the story runs. Lincoln stipulated that the Union Pacific railroad should begin on the Iowa side of the Missouri river, so that the railroad company had to build an expensive, but extremely useful, bridge. At once the geologist gets our ear, for he tells us about the fossils of pre-historic animals uncovered in the gravel through which the railroad grade has been cut. Before we finish with that absorbing foot-note we have gone to Siberia and seen the real fleshly mammoth that was discovered there, held in cold storage by the ice for years untold. Nebraska is "a State without a mine," as if to emphasize the fact that the other states traversed are so rich in mines: Colorado, Wyoming, Utah, Nevada, and California. The mere names trumpet their fame as mineral regions. In the earlier hours of his journey, the traveler's attention is directed to the boulders and vagrant fragments of rock that indicate deposits of glacial origin; whereupon his imagination is quickened by a brief outline of the Great Ice Age and he is given a map that marks the limits of the ancient ice-sheet. From the car-window he sees the southern fork of the Overland Trail that the railway followed and that the western part of the Lincoln Highway is also to follow. This transcontinental automobile road will be 3389 miles long and will traverse 13 States. The work of improving the road is under way. Beyond Cheyenne the sale of fossils suggests the great finds of these beautiful relics of a by-gone period that have been made in the bluffs of the Laramie foothills. A note, with illustrations, describes the extinct animals that flourished in the Miocene period. Then come the coal-fields, with Green River, from which Major Powell started on his famous expedition to explore the canyons of the Colorado. In Utah the geologic history of the Salt Lake arrests the traveler, who is told a great number of interesting facts in such an engaging way that he forgets that it is science that he is imbibing in large draughts. Indeed, the note on Salt Lake is an admirable précis of accurate information. As the railroad nears the various mining centres, the guidebook tells a little of their history and production; it outlines the salient facts in the civic development of this vast mineral territory; it sketches incidents rich in human interest. Many of the photographs are beautiful; some of them are accompanied by diagrams that elucidate the relation of the landscape to the underlying geology. It is an excellent performance. Those who expect to go 'overland' should read this book as an instructive preparation for intelligent travel; those who have crossed it so many times that they have ceased to count their traverses will rejoice that so much useful knowledge should now be readily available to the observer along the well-worn trail that the buffalo, the Indian, the fur-trader, the Mormon, the immigrant, the train, and the automobile have followed successively.

MANUAL OF SURVEYING FOR FIELD AND OFFICE. By Raymond E. Davis. P. 365. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by *Mining and Scientific Press*, San Francisco. Price, $2.50.

This is a textbook of elementary surveying in pocket-book form. The usual subjects are explained thoroughly and clearly, and there are a number of useful tables included. The book is well written, and anyone wishing to obtain a book of its character will do as well to get this one as to purchase any one of a dozen other excellent books of the same kind. On the other hand, it is not apparent that this volume in any way excels the books already published on the same subject. There does not seem to be any valid reason for its publication.

THE RAILROAD TAPER. The theory and application of a compound transition curve based upon thirty-foot chords. By Lee Perkins. P. 356. Illustrated. John Wiley & Sons, Inc., New York, 1915. For sale by the *Mining and Scientific Press*. Price, $2.50.

The well-known topic of tapers or spirals is treated in this volume. As its name implies, the subject is technical and mathematical, and of value to railroad construction engineers. Elevation of the outer rail on a curve is of great importance. The work is an extension and elaboration of that published by W. Hood, some years ago. The book includes 294 pages of tables.

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Construction News Summary

PRESENT STATUS OF ENGINEERING PROJECTS ON THE PACIFIC COAST

(Engineers and others connected with construction work are invited to make use of these columns to acquaint other members of the profession and the general public with the progress of work under their charge.)

PROJECTS OF UNITED STATES RECLAMATION SERVICE

UMATILLA PROJECT, OREGON—A force of 200 men are working on the canal near Coyote. About 38,000 cu. yd. of earth was excavated from the canal-prism during July and about 12,000 lin. ft of canal was lined, requiring 2800 cu. yd. of concrete. H. D. Newell is project manager.

MINIDOKA PROJECT, IDAHO—Drainage pumping station at Boersch Lake has been completed. Road to Boersch Lake dam is being constructed. A number of laterials for the South Side pumping unit have been constructed. Dana Templin, is assistant engineer.

BOISE RIVER STORAGE UNIT, IDAHO—All concrete work on the Arrowrock dam is completed. Lining of discharge trench for spillway is finished and the spillway lip is 80% completed. Work on the log chute and conveyor is under way. The reservoir contains 90,000 acre-feet of water. Charles H. Paul, construction engineer.

GOVERNMENT RAILROAD IN ALASKA

Headquarters have been established at the new town of Anchorage, formerly Ship Creek. Contracts have been awarded for clearing and grading about twenty miles of the railroad. These contracts have been let in small units, to station-men. Over one thousand men are now engaged in the work.

GENERAL CONSTRUCTION IN WASHINGTON

NORTHERN PACIFIC GRADE-SEPARATION AT SPOKANE—Sixty-five per cent of excavation is completed and 90% of retaining-walls.

STATE HIGHWAY—State highway commission has 217 miles of road now under contract, costing in all, approximately $900,000. This includes seven divisions of the Pacific highway, under contract to Montague-O'Reilly Co., Portland, Oregon, Worthen & Satterthwaite, Lynden, Porter & Conley, Inc., Portland, Hendricks & Ward, Centralia, General Construction Co., Spokane, and Charles Lind, Bellingham; one division of the Sunset highway under contract to Mohr Construction Co., Waterville; three sections of the Inland Empire highway, under contract to H. L Wilson Co., Walla Walla, General Construction Co., Spokane, and Quigg Construction Co., Seattle, one section of the Olympic highway, under contract to Rignell and Bankston, Tacoma; state road No. 23, under contract to General Construction Co., Spokane; the Mashell bridge, under contract to H. C. Malott, Seattle; and the Mayfield bridge, under contract to H. H. Beer, Portland. Contract for additional construction costing approximately $250,000 will probably be awarded before the close of the season. In addition to the state work, 207 miles of surfaced roads are being built by the various counties, at a total cost of $1,334,000.

GENERAL CONSTRUCTION IN OREGON

COLUMBIA RIVER CHANNEL—Fifty-three per cent of dredging on channel has been completed. Since July 1, 1914, 1,000,000 tons of rock has been placed in north jetty at Astoria. The south jetty is completed.

WILLAMETTE PACIFIC RAILROAD—This road is to run from Eugene to Marshfield, 126 miles in all. Road is now in operation between Eugene and Mapleton, 57 miles and track has been laid as far as Florence, ten miles farther.

VALLEY & SILETZ RAILROAD—Construction on this road, which will run from Airlie to Independence, was commenced about July 20.

GENERAL CONSTRUCTION IN CALIFORNIA

HARBOR WORK AT EUREKA—South jetty has been completed after three years of work and the expenditure of $1,200,000.

GOVERNMENT WORK ON SACRAMENTO RIVER—Two dredges are working on the channel near Rio Vista. During June 726,408 cu. yd. of material was removed.

KNIGHTS LANDING CUT—Highway bridge has been completed. Cut has been opened so as to be ready for service during the next high-water period, although it has not been entirely excavated. Haviland & Tibbetts are engineers.

SACRAMENTO RIVER WEST SIDE LEVEE DISTRICT—This district contains 107,000 acres between Colusa and Knights Landing. Construction has been commenced.

SHELL PIPE-LINE—Sanderson & Porter report that 155 miles of line has been laid and tested. The line is about 170 miles long. The pumping stations are practically completed.

STATE HIGHWAY WORK—Contracts have been awarded for 39 miles of road costing $194,000, and for three reinforced-concrete bridges costing $34,000.

SAN FRANCISCO MUNICIPAL WORK—Work on the sewer system consisted mainly of the completion of the Mile Rock tunnel and of the sewage pumping station at 48th avenue and Fulton street. This station has a capacity of 4000 gallons per minute. On the Twin Peaks tunnel about 2000 ft. has been completed at the easterly end and somewhat over 1000 ft. on the westerly end. The main structural work on the Eureka Valley station has been completed. Excavation is in progress at the Laguna Honda station. R. C. Storrie & Co. are the contractors. The following links in San Francisco's boulevard system have been completed: Junipero Serra boulevard, Sloat boulevard, parts of Portola drive, 19th avenue boulevard, and the San Bruno avenue extension. The central fire-alarm station in Jefferson square has been completed. M. M. O'Shaughnessy is city engineer.

STATE HARBOR WORK AT SAN FRANCISCO—Post-office building is practically completed and will be occupied early in August. Piers 16 and 18 are completed, and pier 24 is nearly completed. Contract for repair to pier 11 has been awarded to Healy-Tibbetts Construction company, who are building pier 35 and have completed pier 37. Jerome Newman is chief engineer.

MUNICIPAL HARBOR WORK AT RICHMOND—Tunnel is completed and the highway nearly so. The rock sea-wall for the wharf is in place, the concrete piles are being driven, and some of the steel work is being placed. Haviland & Tibbetts are engineers.

ORANGE COUNTY HIGHWAYS—Contracts have been awarded for 117 miles of road, 114 miles has been graded, concrete has been laid on 100 miles, and 102 miles has been finished, the plans not calling for concrete on all roads. S. H. Finley is chief engineer and George R. Wells, office engineer.

RIVERSIDE COUNTY HIGHWAYS—The complete system will include 275 miles of road of which 105 miles are to be paved with concrete and the remainder surfaced with local materials. Contract for the construction of 145 miles of road have been awarded, and 30 miles of concrete pavement have been laid. A macadam road is under construction between Whitewater and Palm Springs. George M. Pearson is chief engineer.

SAN DIEGO & ARIZONA RAILROAD—Tunnels 3 and 4 are completed. Track is laid as far as Tecate and grading is practically completed as far as Campo. E. J. Kallright is chief engineer.

SAN DIEGO HARBOR—Dredging for channel to municipal pier is completed.

General Summary

Condensed From Our Daily Construction News Service.

CALIFORNIA

ALAMEDA—Contract for construction of north side sewer has been awarded to Tibbetts-Pacific Co., San Francisco, for $9679. Engineer's estimate was $10,200.

ANAHEIM—Broadway will be paved for one mile with 4-in. concrete base and sheet asphalt wearing-surface. Estimated cost is $75,000. Work will be undertaken about August 1. Particulars from city engineer.

ARBUCKLE—Citizens are considering formation of lighting district. C. K. Atran is interested.

ARVIN—Landowners in this vicinity are considering forming district to construct 15-mile boulevard to Edison. Warren Pauly, Bakersfield, is interested.

BAKERSFIELD—Contract for furnishing 14,000 tons of

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crushed rock for county highways has been awarded to Grant Rock & Gravel Co., Fresno, for 45c. per ton f.o.b. their quarry, or $1.20 per ton delivered at Rio Bravo.——Contract for furnishing 16,000 tons of crushed rock for county highways has been awarded to Sharp & Fellows Contracting Co., Central Bdg., Los Angeles, for $1.20 per ton, delivered at Wasco.——Southern California Auto Club is promoting project for construction of road to summit of Mt. Whitney. Angus Crites is interested.——Contract for construction of sewers in district No. 25 has been awarded to W. J. Tobin, 735 Filbert street, Oakland, for 57c. per lin. ft. for laying 8-in. vitrified pipe, and 51c. per lin. ft. for laying 6-in. pipe, a total of $3415.71.——Contract for construction of sewers for two blocks on 20th street has been awarded to L. S. Stroud.——Contract for construction of one block of concrete pavement on 20th street has been awarded to Thompson Bros., Fresno.——Contract for construction of section No. 3 of Bakersfield-McKittrick road has been awarded to Castro & Blaisdell, for $4265.80.——Bids will be received until August 10 by board of supervisors for furnishing road scarifier for use in 3rd district——Election will soon be held to vote on bond issue of $200,000 for park purposes. Daniel Harris is park commissioner.

BANNING—Contract for construction of four miles of concrete curb, gutter, and sidewalk has been awarded to M. V. McCombs, for $24,000.

BERKELEY—City commissioners are considering one-light electrolier system. F. T. Robson is commissioner of public works.——Bids will be received until 11 a.m., August 9, by Comptroller of University of California for erection of Benjamin Ide Wheeler hall. Plans and specifications from Comptroller upon deposit of $5.

BIGGS—Landowners in this vicinity will construct drainage ditch. Estimated cost, $1500. H. F. Brink is interested.

BISHOP—H. C. Miller is designing an irrigation system to pump 80 miners' inches through one-half mile of straight pipe against a head of 40 ft. The intake is in a concrete lined sump and the discharge into a ditch. Will use either 6, 8, or 10-in. pipe. Will use gasoline or distillate. Is in the market for all equipment.

COMPTON—Bonds for $70,000 for construction of sewer system have been voted. Olmstead & Gillelen, Hollingsworth Bdg., Los Angeles, are consulting engineers.

EAST SAN DIEGO—City engineer, H. A. Kuehmsted is preparing plans for sewer system. Estimated cost, $50,000.

EUREKA—Contract for construction of reinforced-concrete bridge over Wolverton creek has been awarded to B C. Farnell and J. S. Robinson, for $1123.——Contract for construction of bridge over Eel river at Scotia has been awarded to Mercer-Fraser Co. for $55,160.

FAIR OAKS—Landowners in this vicinity are considering formation of irrigation district containing 19,000 acres to take over existing ditches and construct additional irrigation work. S. E. Kieffer, 57 Post street, San Francisco, is engineer.

FRESNO—Bond election will be called to raise funds for enlargement of sanitary sewers, costing $300,000, additions to storm sewers, costing $175,000, and buildings and equipment for fire department costing $75,000.——County clerk will receive bids until August 4 for construction of 200-ft. reinforced concrete bridge over Fish slough at Elkhorn grade. Plans have been prepared by I. Teilman. Estimated cost is $10,000.——Bids will be received until 5 p.m., August 2, by W. H. Ryan, city clerk, for construction of 6-in. sewer for blocks 364 and 375.——Contract for construction of two-story reinforced-concrete building for Olender Bros. has been awarded to Riggins & Palmer, for $60,000.——Bids will be received until 2 p.m., August 5, by D. M. Barnwell, county clerk, for construction of Badger-Sand Creek road, 2.7 miles long. Scott McKay is county surveyor.——John A. Neu has been appointed chairman of county highway commission, succeeding George S. Waterman, resigned.——Bond election will probably be held in October.——Contract for construction of sidewalks on S street has been awarded to Thompson Bros.——City clerk is receiving bids for construction of sidewalks on Van Ness avenue, and for construction of sewers for blocks No. 364 and 375.——Contract for furnishing an 8 to 12-hp. tractor for street-work has been awarded to Yuba Construction Co., Insurance Exchange Bdg., San Francisco, for $2190.——Atchison, Topeka & Santa Fe railroad will spend $5800 for concrete and asphalt pavement around freight and passenger depots.

FULLERTON—Contract for grading and asphalt concrete pavement on Brea road has been awarded to O. & C. Construction Co., La Habra, for $36,000.

GRIDLEY—All bids for construction of Carnegie library exceeded the amount available, $7000, and they were rejected.——Rights-of-way are being secured for drainage ditches in district No. 1. Austin Jenkins, Henry Wickman, and George Thanter are trustees.

HANFORD—Kings County Highway Commission has decided to furnish materials for county highways and to accept bids for labor only. County clerk will receive bids until August 2 for furnishing 300,000 tons of crushed rock and 1000 tons of asphaltum. Commissioners will soon advertise for bids for construction of first two sections of county highways.——Contract for construction of bridge over Cross creek has been awarded to S. G. Smartt, Bakersfield.

HAYWARDS—All bids for construction of asphalt pavement for a distance of one mile on C street were about $43,000 and were considered too high and rejected. New bids will be advertised for.

HERMOSA BEACH—Contract for construction of city hall has been awarded to Koepke, Harris & McCready, Pioneer hotel, for $8495.

LINDSAY—City council has decided on 200,000 sq. ft. of additional paving. It will consist of a 4-in. crushed rock base and 2-in. asphaltic concrete wearing surface.

LIVERMORE—Contract for construction of lighting system has been awarded to Pacific Fire Extinguisher Co., 507 Montgomery street, San Francisco, for $6273.21.

LONG BEACH—Contract for construction of Belmont pier has been awarded to S. M. Kerns, 625 West Ocean avenue. Pier will be of reinforced concrete.

LOS BANOS—Contract for construction of pavement on 14 blocks has been awarded to W. H. Worswick, Jr., Modesto, for $48.810.37.

LOS ANGELES—Contract for improving Beaudry avenue has been awarded to Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., for $10,411 58.——Contract for improving Taleton street has been awarded to H. C. Withers, Builders Exchange, for $2124.29.——Board of supervisors will receive bids until 2 p.m., August 2, for construction of steel girder bridge over San Gabriel river near El Monte. Bridge will have eleven 80-ft. spans, a reinforced concrete floor, and piers made of steel cylinders filled with concrete——Bids will be received until 2 p.m., August 9, by board of supervisors for construction of improvements in road district No. 1. Estimated cost is $7021.66.——Following contracts for street work have been awarded to F. W. Whittier, 1145 Title Insurance Bdg., for improvement of Wabash avenue for $6872.35; for improvement of Evergreen avenue for $7984.59; for improvement of New Depot street for $1607.86.——Contract for improving Ardmore avenue has been awarded to E. A. Baker, 407 H. W. Hellman Bdg., for $5972.46.——Contract for improving Cambridge street has been awarded to Ford & Stout, Bradbury Bdg., for $17,471.02.——Contract for improving Lincoln avenue has been awarded to R. H. McCray, Jr., 234 West 28th street, for $1773.70.——Contract for improvement of Gramercy place has been awarded to George R. Curtis, 552 South St. Louis street, for $12,373.34.——Contract for construction of brick and concrete building for Jefferson street school has been awarded to Broadway Construction Co., 235 East Washington street, for $27,345.——Contract for construction of brick and concrete building for Seventh avenue school has been awarded to J. F. Atkinson, Story Bdg., for $26,580.——Contract for construction of Hobart boulevard school has been awarded to John B. Dawson, 718 Fay Bdg, for $26,430.——Contract for dredging 115,000 cu. yd. in Los Angeles harbor has been awarded to Standard American Dredging Co., 325 Central Bdg., for $37,869.——Ford & Stout, Bradbury Bdg., have been awarded contracts for improving Figueroa street for $9474 and for improving Pasadena avenue for $6364.57.——Contract for construction of lighting system on Olive street has been awarded to F. O. Engstrum Co., 5th and Seaton streets, for $6498.——Contract for construction of reinforced concrete building for Angeles Mesa school has been awarded to Mann & Knox Construction Co., Delta Bdg., for $26,625.——Contract for construction of Temple street sewer has been awarded to Joe Chutuk, 315 South Gless street, for $39,118.90.——Contract for construction of pavement on Kenmore avenue has been awarded to R. H. McCray, Jr., 234 West 28th street, for $3007.21.——Fairchild-Gilmore-Wilton Co., Pacific Electric Bdg., has been awarded contract for improvement of Kerckhoff avenue for $26,046.75, and for improvement of 32nd street, for $7242.49.——Contract for construction of brick and concrete building for Rowan-Avenue school has been awarded to Huntsberger-Reed Co., Van Nuys Bdg., for $42,496.

MANHATTAN BEACH—Contract for improvement of 9th, 10th, and 11th streets has been awarded to Modern Construction Co., 1006 Wright & Callender Bdg., Los Angeles, for $16,206.15.

MANTECA—Contract for construction of curbs on Yosemite avenue has been awarded to F. C. McIntire, Stockton, for $1226.50.

MARICOPA—Bonds for $15,000 for construction of high school building have been voted.

MARTINEZ—Contract for construction of six 15,000-bbl. steel tanks for Shell Oil Co. has been awarded to Lacy Manufacturing Co., Washington Bdg., Los Angeles. Contract for construction of twenty-six 55,000-bbl. steel tanks has been awarded to

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Llewellyn Iron Works, Main and Redondo streets, Los Angeles.

MARYSVILLE—Contract for construction of three concrete bridges on state highway has been awarded to Jenkins & Wells, Sacramento, for $14,216.——Bond election will be held August 24 to vote on $18,000 issue for extensions to sewer system and other improvements.

MERCED—Board of supervisors will purchase $100,000 worth of state highway bonds, insuring construction of lateral to Mariposa.——Bids will be received until 1 p.m., August 14, by M. C. Grillo, R.F.D. box 111, for altering Catholic church at Buhach.

MODESTO—Board of supervisors will receive bids for construction of bridge over Tuolumne river at Roberts Ferry, until 10 a.m., August 10.——Directors of Modesto irrigation district have taken steps to replace wooden head-gates for lateral ditches with concrete structures. F. C. Herrmann, Merchants Exchange Bdg., San Francisco, is chief engineer.——Contract for construction of earth fill at Gasburg crossing has been awarded by directors of Modesto irrigation district to Tibbetts-Pacific Co., San Francisco, for $54,950.50.——Contract for construction of Southern Pacific depot has been awarded to George A. Bos, Hearst Bdg., San Francisco, for $15,000.——Contract for construction of two county bridges has been awarded to F. F. Fernandez, Hayward, for $3607.——Board of supervisors will receive bids until 10 a.m., August 11, for remodeling interior of court house.

NEEDLES—Contract for construction of bridge across Colorado river has been awarded to Kansas City Structural Steel Co., for $74,250.

NEWCASTLE—Contract for construction of sewer system and disposal works has been awarded to Leach & De Camp, San Francisco, for $2310.

OAKDALE—Burton Smith, chief engineer for Oakdale irrigation district, has prepared plans for 8000-ft. tunnel through Cape Horn. Estimated cost, $50,000.——Bonds for $400,000 of the Oakdale irrigation district have been sold to E. J. Wright Co., Los Angeles, for 90.25 and accrued interest. Bonds bear 6% interest.

OAKLAND—Contract for improvement of parts of 23rd avenue, East 31st street, and Hopkins street, has been awarded to Hutchinson Co., 13th and Franklin streets, for 35c. per cu. yd. for excavation, 1c. per sq. ft. for re-grading, 10c. per lin. ft. for redwood curbs, 14c. per sq. ft. for concrete gutters, 8.8c. per sq. ft. for oil macadam pavement, and 60c. per lin. ft. for 8-in. sewer.——Bids will be received until noon, August 5, by L. W. Cummings, city clerk, for grading and construction of redwood curbs, concrete gutters, and oil macadam pavement on Vermont street.——Contract for furnishing sewer pipe during the coming fiscal year has been awarded to California Pottery Co., 12th and Park streets.——Contract for repairs to Hayward-Dublin road has been awarded to Ransome-Crummey Co., First Savings Bank Bdg., for $2927.

ONTARIO—L. G. Garnsey, 402 Bradbury Bdg., Los Angeles, was low bidder for street improvements at the following figures: Concrete paving on A street with asphaltic oil finish, 7.85c. per sq. ft., concrete paving on A street with cement mortar finish, 9.36c. per sq. ft., concrete paving on Bon View avenue, with asphaltic oil finish, 7.85c. per sq. ft., extra grading on Bon View avenue, ¾c. per sq. ft., total, $23,492.15. White & Gaskill, Long Beach, the next lowest bidders, bid 9½c., 11½c., 9½c., and 4c., respectively, on these items, total $29,291.43.

ORANGE COVE—Contract for construction of school house has been awarded to Olsen & Sinclair, Selma, for $5848.

OROVILLE—Board of supervisors will receive bids until August 7 for construction of eight bridges on state highway. Estimated cost is $40,000.——Charles S. Kaiser, Mechanics Institute Bdg., San Francisco, is preparing plans for hall of records. Bids will probably be called for in August.——Board of supervisors will receive bids in August for construction of sprinkling system for East Gridley. M. C. Polk is county surveyor.

PARADISE—Landowners in vicinity are considering formation of irrigation district and have employed C. S. Compton, 841-56th street, Oakland, as engineer to report on construcion of system. System proposed includes 75-ft. dam and expenditure of $250,000 to irrigate 10,000 acres.

PASADENA—Contract for construction of cement sidewalks on Garfield avenue and on Flower street has been awarded to Cox & Cox, Chamber of Commerce Bdg., for 7¾c. per square foot.

POMONA—Contract for construction of brick hotel-building for W. M. Avis has been awarded to Milwaukee Building Co., Wright & Callender Bdg., Los Angeles, for $55,000.

PORTERSVILLE—Contract for paving several streets with 5-in. concrete base and 1½-in. topeka top pavement has been awarded to Federal Construction Co., Sharon Bdg., San Francisco, for 12.83c. per sq. ft.——Contract for construction of building for Rockford school district has been awarded to Graham & Wymer, Lindsay, for $4398.

QUINCY—Great Western Power Co. has applied for franchise to construct 22,000 volt transmission line, 30 miles long, from Big Meadows dam to plant of Engels Copper Mining Co.——Contract for construction of road in Sierra valley has been awarded to Bradley Engineering Co., Reno, Nevada, for $7600.——O. C. Haslett, president of Truckee Lumber Co., Truckee, has purchased timber-land in Meadow valley and will construct sawmill and timber flume.

REDDING—Lawrence Gardella, Oroville, has purchased 2000 acres of dredging ground in this vicinity and will commence operations at once.——Board of supervisors will receive bids until August 21 for construction of wood and steel bridge over Sacramento river at Kennett. Estimated cost is $20,000.——Contract for construction of steel bridge over Clover creek has been awarded to William Stephens for $3353.

REDONDO BEACH—City clerk is receiving bids for construction of concrete pleasure pier at foot of Emerald street. Estimated cost, $121,000.——Contract for construction of comfort station at end of Diamond street has been awarded to G. A. Mitts, for $1300.

RICHMOND—Contract for building spur track from Los Angeles Pressed Brick Works to Santa Fe tracks has been awarded to Chadwick & Sykes, Crocker Bdg., San Francisco, for $30,000.——John Word, 436-13th street, was low bidder at $14,200.51 for construction of bitulithic pavement on 10th street.

RIVERSIDE—Contract for grading and paving 10.5 miles of road on route No. 7 with 4-in. concrete base, 16 ft. wide, has been awarded to C. L. Hyde Construction Co., Spreckels Bdg., San Diego, for $40,599.05.

SACRAMENTO—Following bids have been received by state highway commission for highway work: In Los Angeles county, Division VII, Route 9, Section A, Kennedy & Williams, Los Angeles, $57,327.80; Peter L. Ferry, Tropico, $45,165; Andrew Holloway, Pasadena, $34,583.40; White & Gaskill, Long Beach, $56,635.50; L. G. Garnsey, Los Angeles, $46,130.45; Tryon & Brain, Los Angeles, $43,758.30; C. T. Salata & H. A. Taylor, Los Angeles, $48,450.90; Rogers Bros. Co., Los Angeles, $50,753.20; M. R. Company, Los Angeles, $49,841.35; Fred Hoffman, Long Beach, $51,089.90; engineer's estimate, $38,576.06. In Santa Clara county, Division IV, Route 5, Section B, Palmer & McBryde, San Francisco, $58,617.20; Bates, Borland & Ayer, Oakland, $50,325.70; Highway Paving & Construction Co., San Francisco, $45,694.50; C. H. and A. W. Gorrill, San Francisco, $48,724.10; J. W. McDonald, Jr., San Jose, $90,305.50; Marin Rock Co., San Anselmo, $44,135.40; Commary Peterson Co., San Francisco, $46,710.20; Ransome-Crummey Co., $48,600.20; Petersen & Grier, San Francisco, $51,929; Tieslau Bros. San Francisco, $59,403; Raisch Improvement Co., San Francisco, $45,884; Blanchard-Brown Co., $54,882.86; engineer's estimate, $53,160.94. In Alameda county, Division IV, Route 5, Section B, Palmer & McBryde, $42,884.40; Blanchard-Brown Co., $43,284.20; M. Blumenkranz, Davis, $43,581.30; C. H. and A. W. Gorrill, $42,222.40; Petersen & Grier, $41,815; Spring Construction Co., Berkeley, $35,884.10; H. G. Vaughan Construction Co., $34,485 75; Marin Rock Co., $39,748.10; Parrott Bros. Co., Salt Lake City, Utah, $37,857; Commary Petersen Co., $42,589.50; P. H. Hoare, Oakland, $43,471.20; W. B. Hunt & Sons, Alameda, $39,230.20; W. J. Schmidt, Berkeley, $41,138; Tieslau Bros., $46,542; Bates, Borland & Ayer, $44,520; engineer's estimate, $44,047.07; for reinforced concrete bridge in Siskiyou county, Pacific Coast Construction Co., Fresno, $26,922; F. Rolandi, San Francisco, $39,700; engineer's estimate, $21,965.63; for two reinforced concrete bridges in Shasta county, F. Rolandi, $5450; engineer's estimate, $4934.08; for bridge across Pit river in Shasta county, Ross Construction Co., $28,235; Carnahan & Mulford, San Francisco, $56,989; F. Rolandi, $50,300; Pacific Coast Construction Co., $32,941; engineer's estimate, $27,146.88; in Contra Costa county, Division IV, Route 14, Section B, F. Rolandi, San Francisco, $39,234 30; Contra Costa Construction Co., Berkeley, $35,979.60; James Fitzpatrick, Sacramento, $39,008.60; T. Manetas and T. H. Mullen, San Francisco, $39,305.70; J. H. Falconer, Pinole, $39,661 95; O'Brien Bros., Martinez, $35,547.70; Spring Construction Co., Berkeley, $38,197; W. A. Bechtel, Alton, $45,296.50; W. B. Hunt & Sons, Alameda, $39,844.15; Hard Bros., Ukiah, $51,185; A. C. McLean Construction Co., San Francisco, $40,425.40; W. J. Schmidt, Berkeley, $36,098.20; Palmer & McBryde, San Francisco, $47,707.60; R. Rothwell, Los Angeles, $34,054.40; Urban Construction Co., San Francisco, $29,832.70; Blanchard-Brown Co., $37,115.70; Bates, Borland & Ayer, Oakland, $33,622 50; Occidental Construction Co., Los Angeles, $38,986.70; Fairbanks & Bachtel, Willits, $34,189.60; G. W. Connors, Eureka, $37,216; engineer's estimate, $46,844.91; in Glen county, Division III, Route 7, Section B, L. F. Gerdetz, San Francisco, $37,327; Marin Rock Co., San Anselmo, $37,204; Highway Paving & Construction Co., San Francisco, $39,865 50; H. G. Vaughan Construction Co., San Francisco, $35,208.55; C. H. and A. W.

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Gorrill, San Francisco, $37,361.50; P. H. Hoare, Oakland, $44,875.50; Taylor & Berliner, Los Angeles, $33,817; W. B. Hunt & Sons, $38,441; engineer's estimate, $42,665.58; in Tehama county, Division II, Route 3, Section C, G. W. Connors, $52,117; James Fitzpatrick, $48,136.70; F. Rolandi, $48,773; H. H. and C. M. Harlan, Williams, $49,214.20; A. C. McLean Construction Co., $54,485.80; R. Rothwell, $60,967; engineer's estimate, $54,093.01; in Tulare county, Division VI, Route, 10, Section A, Shattuck & Nimmo, Bakersfield, $17,522.40; Rogers Bros. Co., Los Angeles, $23,255.50; Highway Paving & Construction Co., $17,439.30; Bent Bros., Los Angeles, $19,542.88; White & Gaskill, Long Beach, $14,812.50; John D. Marsh, Bakersfield, $15,270.20; engineer's estimate, $17,933.75; in Tulare county, Division VI, Routes 4 and 10, Section D and Section B, Shattuck & Nimmo, $32,460.50; John D. Marsh, $30,408.50; Highway Paving & Construction Co., $33,451.50; M. Blumencranz, Davis, $41,415.75; Rogers Bros. Co., $45,666; Taylor & Berliner, $40,504; Bent Bros., $37,953.80; White & Gaskill, Long Beach, $30,377.75; engineer's estimate, $35,060.63.——Contract for construction of state highway in Contra Costa county between El Ciervo and Eckley has been awarded to Bates, Borland & Ayer, Oakland Bank of Savings Bdg., Oakland, for $33,817. Materials furnished by state, $5209.——James Kennedy, Washington Bdg., Los Angeles, was low bidder at about $43,000 for construction of unit No. 4 of trunk sewer.——State Highway Commission has awarded the following contracts: for highway from Red Bluff northerly to Tehama County line to James Fitzpatrick; for reinforced concrete bridge in Shasta county to Ross Construction Co. for $28,235; for two other reinforced concrete bridges in Shasta county to F. Rolandi, 550 Montgomery street, San Francisco, for $5450. All bids for construction of bridge over Sacramento river at Dunsmuir were rejected because too high. R. B. Markle, Jr., Hearst Bdg., San Francisco, was low bidder for construction of 4 miles of state highway between Burdell and St. Vincent in Marin county at 42c. per cu. yd. for excavation, 50c. per lin. ft. for 12-in. corrugated pipe; 60c. for 15-in.; 70c. for 18-in.; $9 per cu. yd. for class B concrete in culverts; a total of $21,255.40, Engineer's estimate was $28,280.11. State furnishes pipe-railing for culverts, reinforcing steel, corrugated pipe, cement, sand, and coarse aggregate; total value, $2934.87. Other bidders were Bates, Borland & Ayer, Oakland, $26,849; Fairbanks & Baechtel, Willits, $29,960.70; T. Manetos, San Francisco, $26,504.80; J. H. Falconer, Pinole, $23,498.60; G. W. Conners, Eureka, $26,885.60; O'Brien Bros., Martinez, $28,220.20; Contra Costa Construction Co., Berkeley, $27,532.40; P. H. Hoare, Oakland, $24,475.80; F. Rolandi, San Francisco, $29,088.60; Palmer & McBryde, $25,489.40; Twohy Bros. Co., San Francisco, $52,084.30; Daniel O'Day, San Francisco, $29,201.40; Tieslau Bros., San Francisco, $28,883; Bauer & Beard, Two Rivers, $27,421.90; W. J. Schmidt, Berkeley, $34,872; Erickson & Peterson, Inc., San Francisco, $34,290.40; Spring Construction Co., Berkeley, $30,857.56; Sunset Construction Co., San Francisco, $31,552.20.——C. H. Hudson, Trust & Savings Bdg., Los Angeles, was low bidder for construction of 11.4 miles of highway between Gaviota pass and Zaca Station at 35c. per cu. yd. for earth excavation, 50c. for loose rock, 70c. for solid rock, 25c. for borrow, 60c. per lin. ft. for 12-in. corrugated pipe; 70c. for 18-in., 80c. for 24-in. 90c. for 30-in., $1 for 36-in., $10 per cu. yd. for class B concrete in culverts, $2 per cu. yd. for dry rubble walls, $3 per cu. yd. for rubble masonry walls; a total of $54,856. State furnishes pipe-railing for culverts, reinforcing steel, corrugated pipe, cement and sand for concrete and masonry, and coarse aggregate for concrete. Engiers' estimate was $62,162.45. Other bidders were Maurice Ryan & Son, El Centro, $65,293; Fairbanks & Baechtel, $69,919.33; L. G. Garnsey, Los Angeles, $67,959.66; Tieslau Bros., $71,802.95; Richard Rothwell, $60,631.75; Bates, Borland & Ayer, $61,564.23; F. Rolandi, $73,685.73; Robert Sherer, Los Angeles, $58,148.23; Occidental Construction Co., Los Angeles, $69,655.55; F. L. Smith Co., Eureka, $59,466 12; F. H. Green, Eureka, $59,994.44; G. W. Connors, $63,004.55; E. J. Hunt, Santa Margarita, $61,831.82.——John D. Marsh, Bakersfield, was low bidder for construction of 10 miles of state highway between Atascadero and Paso Robles, at 50c. per cu. yd. for excavation, 45c. per lin. ft. for 12-in. corrugated pipe; 55c. for 18-in., 60c. for 24-in., 70c. for 30-in., 75c. for 36-in., $8.25 per cu. yd. for class B concrete in culverts, $2.90 per cu. yd. for class B concrete in pavement; 45c. per lin. ft. for guard rail, a total of $67,809.45; State furnishes pipe-railing for culverts, reinforcing steel, corrugated pipe, cement, sand, and coarse aggregate; total value, $56,736.10; engineers' estimate was $71,709.40. Other bidders were F. Rolandi, $72,651.60; W. A. Dontanville, Salinas, $74,491; L. G. Garnsey, $76,362.06; Twohy Bros. Co., $82,791 15; Bent Bros., Los Angeles, $72,495.36; Petersen & Grier. San Francisco, $78,191.25; Tieslau Bros., $74,802.80; Pacific Coast Construction Co., Fresno, $69,386.40; Bates, Borland & Ayer, $75,079.65; Seabury B. Peterson, San Francisco, $74,747.75; C. H. and A. W. Gorrill, San Francisco, $70,864.45.——Highway Paving & Construction Co., San Francisco, was low bidder for construction of 11.7 miles of state highway between Greenfield and Camphora, in Monterey county, at 52½c. per cu. yd. for excavation, 50c. per lin. ft. for 12-in., corrugated pipe, 50c. for 18-in., $1 for 24-in., $12 per cu. yd. for class B concrete in culverts, $3.40 per cu. yd. for class B concrete in pavements, 40c. per lin. ft. for guard rail, a total of $54,507. State furnishes pipe-railing for culverts, reinforcing steel, corrugated pipe, cement, sand, and coarse aggregate; total value, $59,111.50. Engineers' estimate, $83,019.77. Other bidders were C. H. and A. W. Gorrill, $72,847.50; W. A. Dontanville, $69,064.30; Hoffman & McLaren, Oakland, $63,395; Lou G. Hare, Salinas, $76,527.10; Twohy Bros. Co., $85,437; Tieslau Bros., $73,966; Petersen & Grier, $66,733.——Clark & Henery Construction Co., Sacramento, was the only bidder for construction of 0.3 mile of asphalt surfacing in Arbuckle at 57½c. per sq. yd., a total of $5778.75. Engineers' estimate was $5879.25. No materials furnished by state.——State Highway Commission has awarded contract for construction of highway from Rancho Tijunga to La Canada, in Los Angeles county, to Andrew Holloway, Pasadena, for $34,583.40. Contract for construction of highway from San Jose to Los Gatos has been awarded to Marin Rock Co., San Anselmo, for $44,135.40.——Contract for construction of unit No. 2 of sewer system has been awarded to Clinton Fireproofing Co., Mutual Bank Bdg., San Francisco. Contract for construction of unit No. 4 has been awarded to James Kennedy, Washington Bdg., Los Angeles.——State Highway Commission will receive bids until 2 p.m., August 23, for construction of reinforced-concrete bridge near Dunsmuir, 532 ft. long, with one 180-ft. arch and two 114-ft. arches. Bids for this work have already been received once, but they all exceeded the engineers' estimate of $21,965.63 and were rejected.——State Highway Commission will receive bids in August for construction of highway from Greenfield to Camphora, 11.7 miles, and from Gaviota Pass to Zaca Station, 11.5 miles. State highway has decided to build lateral to Nevada City via Auburn instead of Marysville.——Contract for resurfacing J street has been awarded to Clark & Henery Construction Co.——State highway bonds for $1,215,000 have been sold through the different counties to Byrne & McDonnell, San Francisco, at prices ranging from 93 to 95.——Bids will be received until noon, August 10, by W. F. McClure, state engineer, for construction of sewer for state normal school at Fresno. Plans and specifications from State Department of Engineering upon deposit of $5.——Contract for improvement of V street and of Schley avenue has been awarded to F. E. Frey.——Contract for improvement of U street has been awarded to McGillivray Construction Co.——Landowners are considering cleaning out of bed of Butte slough. George E. Springer, secretary of reclamation district No. 70, is interested.——Contract for supplying fuel oil for county hospital has been awarded to Standard Oil Co. for 90c. per bbl.——Contract for supplying fuel oil for courthouse has been awarded to Associated Oil Co. for 85c. per bbl.——State Highway Commission has decided to sell $2,500,000 worth of highway bonds to provide funds for construction purposes.——State Engineering Department was to commence survey in August for deep-water ship-canal to San Francisco bay.——State Highway Commission has authorized survey of road from Auburn to Grass Valley.

SALINAS—Contract for macadamizing Alisal street has been awarded to Granite Rock Co. for $20,268.40.

SAUSALITO—Contract for sewer construction has been awarded to Austin De Camp, 403 Nevada Bank Bdg., San Francisco, for 90c. per lin. ft. for 6-in. ironstone pipe, $1.71 per lin. ft. for same pipe embedded in reinforced concrete, 30c. each for 6-in. wyes, $40 each for manholes, and $10 each for lamp-holes. L. L. Hohl is city engineer.

SAN DIEGO—City will purchase 15,000 lin. ft. of 4-in. and 6-in. water-pipe and 240 ft. of 24-in. pipe. Pipe will be purchased in open market without bids. Fred. M. Lockwood is city manager——Contract for improving 30th street has been awarded to G. R. Daley for $6804.63.——Contract for grading Edgemont street has been awarded to C. L. Hyde Construction Co., for $4426.67.——Contract for construction of arena at Tia Juana has been awarded to Decker & Dyer.

SAN FRANCISCO—Following street work has been ordered: sewers on Hill street and Harkness street, asphalt pavement on Collins street, curbs, catchbasins, and asphalt pavement on Ecker street, sidewalks and asphalt pavement on Stark street, curbs, basalt gutters, and basalt block pavement on Castro street, sewers on Arleta street, Wilde avenue, and Leland avenue, curbs and asphalt pavement on Sickles avenue, curbs, sidewalks, and basalt pavement on Mateo street.——Northern Electric Railroad Co. will commence repairs of bridge over Sacramento river at Meridian. Estimated cost, $50,000, which will be borne jointly by the Company, Sutter county, and Colusa county. J. P. Coghlan, Hobart Bdg., is receiver for the Company.——Board of public works has ordered the following street work: curbs, sidewalks, catchbasins, culverts, and basalt and asphalt pavement on McAllister street; grading on Quint street; sidewalks, curbs, and basalt and asphalt pavement on

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Vermont street; sidewalks, curbs, sewers, and asphalt pavement on Mariposa street.——John Bollman Co., Battery and Commercial streets, is considering erection of $300,000 factory building at 4th and Brannan streets.——Contract for repairing pier No. 11 has been awarded by board of State Harbor Commissioners to Healy-Tibbetts Construction Co., Main and Market streets, for $14,281.——Bureau of Foreign and Domestic Commerce, 306 Custom House, has information regarding firm in Peru which wishes to correspond with manufacturers of wood-working machinery, automatic punches, rivet-cutting machinery, lathes, wire nails, shovels, lead pipe, and zinc plates.——Contract for construction of first section of Twin Peaks boulevard has been awarded to Eaton & Smith, 11th and Harrison streets, for $24,058.——Contract for construction of bascule bridge at 4th street has been awared to Thompson Bridge Co., 103 Main street, for $84,287.——Board of Harbor Commissioners have awarded contract for extension of pier No. 20 to Healy-Tibbetts Construction Co., Main and Market street, for $9421.——Contract for completion of second story of United States subtreasury has been awarded to Construction Engineering Co., Inc., 1047 Folsom street, for $9760.——Bureau of Foreign and Domestic Commerce, 306 Custom House, has information regarding firm in New Zealand that is in the market for builders' hardware, plumbing supplies, gas pipes, etc. Inquirers should mention opportunity No. 17,476.

SANGER—Following bids were received for construction of two miles of macadamized streets: from J. W. Haynes, Oakland, $19,953; from Thompson Bros., Fresno, $18,765.——Contract for construction of Carnegie library has been awared to W. H. Jones, for $9500.

SAN JOSE—Contract for construction of reinforced-concrete bridge over Campbell creek has been awarded to M. E. Kilcourse, for $4387.——Contract for construction of reinforced-concrete bridges over Calabasas and San Tomas creeks has been awarded to John Doyle, for $2367.——Contract for reinforced-concrete bridge over Permanente creek has been awarded to John Doyle, for $3363.——Bids will be received until 11 a.m., August 2, by H. A. Pfister, county clerk, for construction of reinforced-concrete bridge over Guadalupe creek.——Contract for construction of reinforced concrete bridges on Alviso road and construction of reinforced-concrete bridge at San Martin has been awarded to William Martin for $2229 and $829 respectively.——Ransome-Crummey Co., First Savings Bank Bdg., Oakland, was low bidder at $31,854.05 for improving Tully, White, and San Felipe roads.——All bids received for furnishing 50,000 bbl. of cement to county were identical and they were rejected. Bids ranged from $2.40 to $2.63 per bbl. according to point of delivery.——Contract for construction of reinforced-concrete bridges on Quito and Pollard roads has been awarded to C. J. Meyerholz & Son, for $7272.——Contract for furnishing county with 29,000 lin. ft. of 1-in. galvanized pipe has been awarded to Mark-Lally Co., 2nd and Tehama streets, San Francisco, for $2307.83.——Contract for furnishing fifteen 3000-gal. redwood tanks has been awarded to Alphonse Lorentz, for $461.25.——Contract for furnishing 5125 cu. yd. crushed rock has been awarded to Stanfield & Knowles, for $5688.75.——Peninsular Electric Railroad has been granted franchise for road to Alum Rock park. F. E. Chapin is general manager.——Contract for repair of dam for municipal lake has been awarded to M. E. Kilcourse, for $300.

SAN LUIS OBISPO—Contract for construction of steel and concrete bridge at Miles Station has been awarded to Gottlieben Bros., San Francisco, for $21,700.——Contract for construction of reinforced-concrete bridge over Soper creek has been awarded to E. J. Hunt, for $2245.——Bids will be received until 10 a.m., August 3, by F. J. Rodriguez, county clerk, for construction of several small concrete or reinforced-concrete bridges. A. F. Parsons is county surveyor.——Supervisors have purchased $135,000 worth of state highway bonds, insuring completion of road from Atascadero to Paso Robles.

SANTA ANA—East First street will be paved for one-third mile. Pavement will be 20 ft. wide, and will be composed of 4-in. concrete base and ½-in. bituminous top. Estimated cost is $12,000. Work will be undertaken about August 1. Particulars from city engineer.——Oscar Ford was awarded contract for construction of Garden Grove-Westminster road at 25c. per cu. yd. for excavation, 7c. per lin. ft. for shaping roadbed, $10 per cu. yd. for class A concrete, and $1.85 per cu. yd. for class B concrete, a total of $10,606.01. Engineer's estimate was $12,033.51.

SANTA BARBARA—Contract for construction of 8 miles of vitrified pipe sewer, ranging from 6 to 12 in., has been awarded to Eggert & Ukropina, for $20,717.——Contract for construction of Mission creek reinforced-concrete bridge has been awarded to Munoz & Munoz, Central Bdg., Los Angeles, for $18,973. Plans prepared by city engineer were adopted ——Election of vote on bond issue to provide funds for construction of bridges on state highway, county highway system, county hospital, and detention home will be held in August. Date of election and amount of issue have not yet been determined.

SANTA CRUZ—Contract for paving, sewering, and curbing Plymouth street, has been awarded to B. Byrne, for $13,561.04.

SANTA ROSA—Contract for construction of Elmore bridge has been awarded to W. L. Proctor, for $887 for bridge, 23½c. per cu. yd. for earth embankment, and 90c. per cu. yd. for gravel.——Odd Fellows will erect $50,000 mausoleum. C. S. Langley is interested.

SIERRA MADRE—E. A. Clayton, Bairdstown, has been awarded contracts for improving Hermosa avenue for $4843.91, and for improving Adams street, for $3199.84.

STOCKTON—Pacific Gas & Electric Co. will spend $31,000 on extensions to water-mains.——Plans for street-work costing $86,000 have been adopted and bids will soon be received. G. W. Pulich is city clerk.——County purchasing agent has been authorized to purchase motor truck for county hospital.——Contract for improvement of New Hope Landing road has been awarded to Irey & McCleary, Lodi.——Contract for furnishing fuel oil to county for coming fiscal year has been awarded to Pinal Dome Oil Co., Santa Maria, for $0.84 per bbl.——Only one bid for erection of pumping plant in city park complied with specifications and as that was not the lowest, all bids were rejected.——Contract for construction of sewers in McCloud's addition has been awarded to W. J. Tobin, 735 Filbert street, Oakland, for $5587.46. Engineer's estimate was $6601.35.——City clerk is receiving bids for construction of storm water sewer on East street.——Contract for construction of building for Montezuma school has been awarded to C. R. Petzinger, for $4953.——Contract for construction of sanitary sewers in McCloud's additions has been awarded to A. Teichert & Sons, Sacramento, for $6968.35.——Contract for construction of sewers in southwest part of city has been awarded to E. C. Hamlin, San Jose, for $3401.75.——Contract for macadamizing Yosemite avenue in Manteca has been awarded to F. C. McIntire, for $3000.

SUSANVILLE—Bids will be received until 11.30 a.m., August 3, by county clerk, for erection of county hospital costing $20,000 and a courthouse costing $80,000. Plans for both structures on file with county clerk and at 1005 K street, Sacramento.

THERMALITO—Landowners in this vicinity are considering formation of irrigation district.

TRINITY CENTER—Syndicate has been formed to prospect 1500 acres of placer ground. E. A. Wiltsee, Pacific Union Club, San Francisco, is interested.

UPLAND—Contract for improving Washington boulevard has been awarded to George Snyder Contracting Co. for 9c. per sq. ft. for 4-in. concrete pavement with oil and screening surface. Total cost, $11,000.

VISALIA—Board of supervisors will receive bids until early in August for construction of road through mountains from Lemon Cove to Three Rivers. Estimated cost, $25,000. Byron Lovelace is county surveyor.——Mount Whitney Power Co. has applied for permission to issue $440,000 in bonds, in order to raise funds for purchase of system of Tulare County Power Co.——Bond issue of $65,000 for sewer extensions of $50,000 for municipal auditorium were both carried.

WEAVERVILLE—Corona de Oro Mining Co. will construct flume 2½ miles long at Hawkins Bar. Estimated cost is $25,000.

WOODLAND—About two miles of street paving is being considered. Work will probably be started on September 1. Estimated cost is $30,000. C. E. Arnold is city engineer and M. F. Packer superintendent of streets.——Supervisors are considering bond issue of $189,000 for construction of 21 miles of highway across county.

YREKA—Bids will be received until August 2 by board of supervisors for grading 2½ miles of road between Ager and Thrall. Work includes 9000 cu. yd. excavation.——Contract for furnishing electric pump for municipal waterworks has been awarded to Henry R. Worthington, Sharon Bdg., San Francisco, for $1197.

YUBA CITY—Contract for repair of levee in district No. 1, has been awarded to Hewitt & Felch, Marysville, for 32c. per cu. yd. About 10,000 cu. yd. is to be moved.

OREGON

BAKER—Contract for construction of two steel highway bridges near Robinett has been awarded to Coast Bridge Co., Railway Exchange Bdg., Portland, for $1525.——City engineer L. R. Stockman is preparing plans for Myrtle street bridge. Estimated cost is $2500.——City council has authorized extension of Campbell street watermain. Estimated cost, $1150.

BEAVERTON—Bonds for $23,500 for construction of high-school building have been voted.

THE DALLES—Contract for construction of road across Tygh and White rivers has been awarded to Henry Cromer, Lents, for $15,611.

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EUGENE—Bids will probably be called for in August for construction of wooden Howe-truss bridge across Willamette river. Bridge will have one 200-ft., one 56-ft., and one 30-ft. spans and two concrete piers on pile foundations. Estimated cost, $10,000. ——Contract for grading and graveling county road No. 309½ near Leaburg has been awarded to Roylance & Messinger for $1.82 per 100 ft. for clearing and grubbing, 24c. per cu. yd. for earth excavation, 80c. for rock excavation, and 95c. for gravel. ——Contract for grading and surfacing road No. 56 near Vida has been awarded to Roylance & Messinger for $8 per 100 ft. for clearing and grubbing, 22c. per cu. yd. for excavation, and 85c. per sq. yd. for surfacing. Total cost, $1647.10.——Bids will probably be called for in August for construction of 20-ft. reinforced concrete bridge 11 miles from town.——Contract for construction of Coast Fork bridge has been awarded to Portland Bridge Co., Yeon Bdg, Portland, for $9450. Contract for construction of concrete bridge near Eugene has been awarded to A. Lombard for $890. H. W. Libby is county surveyor.

GRANTS PASS—Contract with Twohy Bros., 219 East 60th street, Portland, which insures building of road to Crescent City, Cal., has been ratified by voters.——Rogue River Public Service Corporation has been granted franchise for light and power system.——Bids will be received until 10 a.m., August 4, by E. L. Coburn, county clerk, for construction of 300-ft. bridge over Sucker creek. Plans from Horace C. Hall.

JACKSONVILLE—Bids will be received until 11 a.m., August 4, by G. A. Gardner, county clerk, for construction of part of Pacific highway. Work will be let in four units and includes in all about 20,000 cu. yd. excavation, together with tile drains, corrugated culverts, and concrete in structures. Plans on file with county highway engineer, Central Point, or with county clerk.

LAKEVIEW—Southern Pacific Co. will build 30-mile extension of railroad from Riverside to Crane Creek Gap. Estimated cost $1,500,000.

MEDFORD—Barnum railroad line has been sold to Bullis Traction Co. Line will be electrified and an extension built.

PENDLETON—Pacific Telegraph & Telephone Co. will spend $5500 on improvements to system.——Plans for $35,000 Carnegie library have been approved. Johnson & Mayer, Commercial Club Bdg., Portland, are architects.——Plans are being prepared for 13 blocks of pavement.

PORTLAND—Contract for construction of concrete pavement on Brooke street has been awarded to Giebisch & Joplin, Rothchild Bdg., for $14,071.49.——Contracts for construction of pavement on 49th street and on Minnesota avenue, have been awarded to Cochran-Nutting Co., 415 South Hayes street, St. Johns, for $7022.80 and $2668.18 respectively.——Contract for construction of pavement on 13th street has been awarded to Star Sand Co., Board of Trade Bdg., for $3558.50 ——Contract for construction of pavement on 39th avenue has been awarded to Bodman & Burge for $1232.47.——Oregon-Washington Railroad & Navigation Co. is receiving bids for construction of terminal buildings at Pilot Rock and at The Dalles. Estimated cost is $400,000. J. R. Holman is chief engineer.——Contract for construction of five-masted wooden schooner for McCormick Lumber Co., has been awarded to St. Helens Shipbuilding Co. for $125,000.——County commissioner Rufus Holman is considering construction of 23-mile wagon road from Mount Hood Lodge to Summit House. Estimated cost, $60,000.——County commissioners will re-advertise for bids for construction of bitulithic pavement on St. Helens road. Concrete base will be used on sections B, G, H, and I, and crushed rock on section A. ——Contract for construction of addition to Albina Homestead school has been awarded to Parker & Banfield, 104 Grand avenue, for $14,617.——Miami Quarry Co., care A. C. U. Berry, Selling Bdg., was low bidder at $176,415.50 for enlarging and repairing wharves and construction of jetties on Siuslaw river. ——Contract for construction of 320-ft. steel bridge for Linn county has been awarded to Pacific Iron Works for $13,383.

ROSEBURG—Construction of railroad that the city and Kendall Bros. are to build jointly will probably commence as soon as a decision from the Supreme Court is received regarding the validity of the bonds voted at the recent election. This is expected about August 10.——Allis-Chalmers Co., Milwaukee, Wis., have been awarded contract for erection of $400,000 lumber-mill for Kendall Brothers.

SALEM—Contract for furnishing 10,000 cu. yd. crushed rock for use on state highway near Medford, has been awarded to Medford Concrete Construction Co., Medford, for prices ranging from $1.73 to $1.85 per cubic yard.

TILLAMOOK—Contract for improvements of county road has been awarded to Arenz Construction Co., Salem, for $33,227.25.

UMATILLA—Contract for construction of water system for Oregon-Washington Railway & Navigation Co. has been awarded to Pike & O'Neill, Portland, for $10,000.

WARRENTON—Contracts for construction of municipal water system and for laying water-main from Clatsop to Seaside have been awarded to C. H. Green, 703 Paulsen Bdg., Spokane, Wash., for $150,000.

UTAH

BINGHAM—Bonds for $17,000 for extensions and improvements to municipal water system have been voted.

CORINNE—Bids will be received until August 21 by commissioners of Corinne drainage district for construction of drainage system for district. Estimated cost $175,000.

LOGAN—Olaf Nelson was low bidder at $66,161.70 for construction of water system.

OGDEN—Contract for construction of pavement on Madison avenue has been awarded to P. J. Moran Co., Salt Lake City, for $28,279.79.

SALT LAKE CITY—Contract for construction of sheet-asphalt pavement on North Temple street has been awarded to P. J. Moran for $5335.93.——Contract for construction of sheet-asphalt pavement on 4th West street has been awarded to G. A. Heman for $9610.70.——Work on irrigation project, including large dam in Devil's Gate valley, will be commenced soon. A. K. Chatfield, 45 Church street, is interested.——Lower Mill Creek Irrigation Co., will construct pipe-line costing $25,000.——G. W. Holmberg, county road supervisor, has recommended the following expenditures for road improvements: $51,660.59 for 25 23 miles of roads, $4682 20 for construction of bridges and repair of old ones, $8142.84 for rock-bins for handling road materials, $2500 for concrete conduit on 14th street, $3300 for additional street lighting facilities, $2505 for rock crusher in Parley's canyon.——Utah Light & Power Co., will spend $1,000,000 for improvements during coming year. C. E. Groesbeck is general manager.——Electric Bond & Share Co., New York, has completed preliminary negotiations for merger of all the hydro-electric power companies in southern Idaho, involving about $14,250,000. It is probable that companies in other parts of the state will be included later.——Right-of-way over Government land has been granted to Southwestern Pacific railroad, incorporated to build road from Denver to San Diego through southern Utah and Arizona. Rolla E. Clapp is interested.——J. F. and H. E. Schraven were low bidders at $61,636 for construction of school at 13th and 7th streets.——Four miles of concrete road will be built in Davis county. Work will be under direction of E. R. Morgan, state road engineer.——Oregon Short Line will make improvements to viaduct on North Temple street, costing $150,000. C. Stradley is chief engineer.

WASHINGTON

ABERDEEN—R. H. Thomson, 520 Alaska Bdg, Seattle, has reported in favor of water-system from Wishkah river. Estimated cost is $500,000.

ANACORTES—Contract for construction of concrete pavement on State street has been awarded to N. W. Ball, Box 142, Seattle, for $8384.94.

CENTRALIA—H. G. Fleischauer has secured franchise for power-plant and will start construction soon.——Contract for improvements on Salzer road has been awarded to J. L. Hendricks.——Contract for improving part of J. P. Dosser road has been awarded to Andrew Keto & Son for $3400.

CHEHALIS—Contract for construction of one mile of concrete road has been sublet to Speaker & McGee.

CHENEY—Contract for construction of girls' dormitory has been awarded to Cheatham & Sons, Spokane, for $35,000.

COLFAX—Contract for construction of 60-ft. bridge at Pullman has been awarded to C. H. Huber, Central Bdg., Seattle, for $3769.——Contracts for 40-ft. span at Clinton and 25-ft. span at Garfield have been awarded to H. C. Malott, 652-17th avenue N E., Seattle, for $1672 and $1536 respectively.——Contract for 30-ft. span at Farmington has been awarded to W. A. Lauder for $1745.——Contract for laying 3200 lin. ft. of 12-in. water-pipe has been awarded to Thomas Ristvedt and Berg Bragg.

ELMA—Contract for construction of 265-ft. steel bridge over Chehalis river has been awarded to Coast Bridge Co., Railway Exchange Bdg., Portland, Oregon, for $11,000.

EVERETT—Contract for construction of fill at bridge No. 221 has been awarded to Reinseth Bros. for $882.——Contract for construction of permanent highway No. 17 has been awarded to Ward & Templeton, for $9509.92.——Contract for construction of highway No. 18 has been awarded to Ward & Templeton, for $13,694.

FERNDALE—Contract for construction of two-course concrete pavement has been awarded to Tropman & Boerhave, Lynden, for $1.05 per sq. yd., or $12,485 in all.

GOLDENDALE—Contract for construction of permanent highway No. 4 has been awarded to Transfer & Livery Co., Hood River, for $20,950.

ISSAQUAH—Contract for construction of school building has been awarded to William Wills, Crary Bdg., Seattle, for $23,799.

KELSO—Landowners in this vicinity are considering the formation of an irrigation district. Magill, McKenney & Brush are interested.

MT. VERNON—Contract for construction of two-course concrete pavement for permanent highway No. 2-A has been award-

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ed to Ferch & Gass, White Bdg., Seattle, for $26,595.——Contract for construction of concrete pavement on Cleveland street has been awarded to N. E. Norris, Burlington, for $10,469.25.

NEWPORT—Contract for construction of courthouse has been awarded to T. W. Hartness, Spokane, for $19,648.

NORTH YAKIMA—Contract for construction of drainage system in district No. 4 has been awarded to Mitchell Bros. & Payne, Spokane, for $5895.40.

OKANOGAN—Contract for construction of permanent highway No. 8 has been awarded to Chas. C. Pugh, Tonasket, for $4300.——Contract for construction of $600,000 system for West Okanogan irrigation district has been awarded to Guthrie, McDougal & Co, Pittock Bdg., Portland, Oregon.

OLYMPIA—Contract for construction of Mashell bridge has been awarded to H. C. Malott, 652-17th avenue N.E., Seattle, for $7850. Bridge will be of reinforced concrete.——Bids will be received until 2 p.m., August 9, by state highway commission, for construction of 195-ft. steel riveted-truss bridge over Skokomish river.——Bids will be received until 2 p.m., August 9, by state highway commissioners for construction of five miles of highway from Colville south.

PORT ORCHARD—Contract for street improvements including concrete sidewalks, curbs, etc., has been awarded to L. L. Lent, Bremerton, for $3604.

PORT TOWNSEND—Nettleton, Bruce & Eschbach, American Bank Bdg., were low bidders at 15½c. per cu. yd. for about 98,000 cu. yd. excavation.

PULLMAN—Contract for construction of street improvements in districts No. 22 and 23 has been awarded to Poe & Co., Moscow, Idaho, for $4704 and $4236 respectively.

SEATTLE—Contract for construction of Woodinville-Duval highway has been awarded to Booker, Kiehl & Whipple, Central Bdg., for $45,214.——Contract for grading and paving West Willow street has been awarded to L. Coluccio, 1642 Lane street, for $7948.72.——Contract for grading on 16th avenue has been awarded to Argenteri & Co, for $4617.24.——Contract for construction of highway No. 7-A has been awarded to Sloane Bros., 1717 Belmont avenue, for $14,402.90.——County commissioners will receive bids until 10 a.m., August 2, for construction of highway No. 7-B between Issaquah and Fall City. Estimated cost is $30,000.——Contract for construction of pavement on West Stacy street has been awarded to L. R. Ellis, Central Bdg., for $10,509.75.——Contract for construction of pavement on 37th place has been awarded to R. G. Stevenson, 1327 Ewing street, for $12,259.——All bids for construction of four miles of highway from Renton Junction to Duwamish have been rejected and new ones will be received by county commissioners until 2 p.m., August 9.——Bids will be received until 10 a.m., August 16, for construction of 440-ft. frame trestle over Judd creek.——County commissioners will receive bids until 11 a.m., August 2, for grading and graveling seven miles of permanent highway No. 11 Estimated cost is $75,000.——Contract for construction of road from Medina, 2¼ miles long, has been awarded to G. Banderet, Renton, for $16,498.——Contract for construction of steel bridge at Tolt has been awarded to M. P. Zindorf, Alaska Bdg., for $27,522.——Contract for construction of cold storage plant has been awarded by port commission to Fire Protection Equipment Co. Central Bdg., for $12,180.——Contract for construction of paving on Horton street has been awarded to D. H. Traphagen, Arctic Club, for $20,555.——Contract for construction of 2-story reinforced-concrete addition to Ferry Museum has been awarded to John Wallin, 850 So. Fife street, for $3000.——Hans Pedersen, Madison Block, was lowest bidder at $242,620.30 for construction of 15th avenue bridge over Lake Washington canal.

SPOKANE—The Rex mine has been sold to a syndicate of which J. O. Stewart is a member. Considerable new equipment will be purchased.

SPRAGUE—City council will erect electric pumping-plant for municipal water-works, including 25-hp. motor and pump to deliver 300 gallons per minute.

TACOMA—Contract for construction of 92,230 sq. ft of cement sidewalks has been awarded to S. R. Gray for $9695.

VANCOUVER—Contract for construction of Camas road has been awarded to J. P. Swanson, for $10,000.

WALLA WALLA—Pacific Telephone & Telegraph Co. will make improvements in system costing $20,000.——Work will soon be started on the St. Mary's hospital. Work will be done by day labor under the supervision of the architect, Robert Tegen, Morgan Bdg., Portland, Oregon.

WATERVILLE—Bids will be received until 2 p.m., August 17, by county commissioners for grading, draining, and surfacing with gravel or crushed rock 3½ miles of permanent highway near Orondo. Estimated cost is $20,000. Plans and specifications on file with Robert F. Foster, county engineer.

WENATCHEE—Contract for construction of permanent highway No. 7, including considerable rock excavation, has been awarded to Quigg Construction Co., for $16,000.——Contract for construction of Malaga road has been awarded to J. Garland for $14,797.

Engineering Societies and Conventions

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Charles McGonigle, president, care Western Sheet Metal Works.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

San Francisco Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. F. W. Gay, secretary, care J. G. White & Co., Alaska Commercial building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, secretary, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. W. K. Barnard, secretary, 701 Central building, Los Angeles.

Coming Conventions

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, San Francisco, University of California, and Stanford University, August 2-7. Albert L. Barrows, associate secretary, Pacific division, University of California Library, Berkeley, California.

AMERICAN ELECTROCHEMICAL SOCIETY, San Francisco, September 16-18. J. W. Richards, secretary, South Bethlehem, Pennsylvania.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. San Francisco, August 25-28. J. C. Olsen, secretary, Cooper Union, New York.

AMERICAN INSTITUTE OF MINING ENGINEERS, San Francisco, September 16-18. Bradley Stoughton, secretary, 29 West 39th street, New York.

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, San Francisco, September 16-18. F. L. Hutchinson, secretary, 33 West 29th street, New York.

AMERICAN MINING CONGRESS, San Francisco, September 20-25. J. F. Callbreath, secretary, Washington, D. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, San Francisco, September 16-17. Calvin W. Rice, secretary, 29 West 39th street, New York.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, San Francisco, September 16-18. J. J. Blackmore, secretary, 29 West 39th street, New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS, San Francisco, September 16-19. Charles Warren Hunt, secretary, 220 West 57th street, New York.

AMERICAN GAS INSTITUTE. San Francisco, September 27 to October 1. George G. Ramsdell, secretary, 29 West 39th street, New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. San Francisco, October 4-9. E. B. Burritt, secretary, 165 Broadway, New York.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS. San Fran-

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cisco, September 21-22. F. M. White, secretary, Madison, Wisconsin.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. San Francisco, September 23-24. W. H. Ross, secretary, 154 Nassau street, New York.

CALIFORNIA CONFERENCE ON CITY PLANNING. Oakland, September 7-11, Charles H. Cheney, secretary, Crocker Bdg., San Francisco.

INTERNATIONAL GAS CONGRESS. San Francisco, September 27 to October 1. George G. Ramsdell, secretary, 29 West 39th street, New York.

INTERNATIONAL ENGINEERING CONGRESS, San Francisco, September 20-25. W. A. Cattell, secretary, Foxcroft building, San Francisco.

INTERNATIONAL IRRIGATION CONGRESS, Stockton, September 13-14; Fresno, September 15-16; Sacramento, September 17-18; San Francisco, September 20. Arthur Hooker, secretary, Sacramento, during July; Stockton, during August and September.

LEAGUE OF CALIFORNIA MUNICIPALITIES, Oakland, September 7-11. H. A. Mason and W. J. Locke, secretaries, Pacific building, San Francisco.

PACIFIC HIGHWAY ASSOCIATION OF NORTH AMERICA, San Francisco, August 11 and 12. H. L. Bowlby, executive officer, 510 Chamber of Commerce building, Portland, Oregon.

PAN-AMERICAN ROAD CONGRESS, Oakland and San Francisco, September 13-18. Charles P. Light, secretary, Colorado building, Washington, D. C.

TRI-STATE GOOD ROADS ASSOCIATION. San Francisco, September 13-14. George E. Boos, secretary, Medford, Oregon.

Personal

J. W. HAMILTON has been appointed city engineer of Pasco, Washington.

ALVIN HORWEGE has been appointed city engineer of Petaluma, California.

P. C. WRIGHTER has been appointed city engineer of Lewiston, Idaho, succeeding R. A. BONNELL.

JOHN A. NEU has been named as member of the Fresno County highway commission, succeeding GEORGE S. WATERMAN, resigned.

H. A. WHITNEY, formerly hydraulic engineer for the city of San Diego, has been appointed consulting engineer for the California state highway commission.

WILLIAM WELLS, of Woodland, California, has been retained by parties interested in the formation of the Southern Lassen irrigation district in Lassen county, California, to report on the entire project.

L. B. DAVIS, of Oakdale, California, has been retained by the board of supervisors of Stanislaus county to make a complete survey of all the county roads, with a view of rectifying errors in right-of-way deeds.

CHARLES GILMAN HYDE, of Berkeley, has been appointed consulting engineer, and CHESTER G. GILLESPIE, of San Francisco, chief engineer of state department of sanitary engineers, recently established by the California state board of health.

J. I. HORROCKS, who was engineer and superintendent for the Chicago, Milwaukee & St. Paul railroad during the construction of the Snoqualmie tunnel, has opened offices as a general contractor at 215 Crary building, Seattle, Washington.

Obituary

JOSEPH A. HOLMES, director of the United States Bureau of Mines, died July 13 at his home in Denver, Colorado.

JOHN G. SCURRY a pioneer railroad engineer on the Pacific coast, and one of the original locating engineers for the Union Pacific railroad, died July 15 at his home in Seattle, Washington.

HORATIO WEBER BAKER, for the past few months advertising manager for WESTERN ENGINEERING, died in San Francisco, July 8, 1915, after a brief illness following an operation for appendicitis.

Mr. Baker was born in Urbana, Illinois, July 9, 1879. His father, Ira Osborn Baker, has been professor of civil engineering at the University of Illinois for about forty years, and is well-known as the author of a number of books on civil-engineering subjects. His mother was the late Emma Burr Baker. Mr. Baker was graduated in civil engineering from the University of Illinois in June, 1901, and for several years was engaged in engineering work with various railroads in the East and Middle West. He then came to Reno, Nevada, to take the chair of civil engineering at the University of Nevada. Eighteen months later, he came to San Francisco, where he became associated with the *Mining and Scientific Press* and with WESTERN ENGINEERING. He continued with these periodicals until his death.

On January 3, 1906, Mr. Baker was married to Miss Hallie Moulton, daughter of Mr. and Mrs. Irving F. Moulton of San Francisco, who survives him.

Commercial Paragraphs

The SCHAW-BATCHER CO., 356 Market street, San Francisco, has been awarded a contract for furnishing six compression tanks for the municipal gas-works at Santa Clara, California.

The ORENSTEIN-ARTHUR KOPPEL CO. has compiled a book of valuable data concerning road-construction which may be obtained by applying to the San Francisco office of the Company.

The jury of awards of the Panama-Pacific Exposition has awarded to the PELTON WATER WHEEL CO. a grand prize for water-wheels and accessories, a gold medal for turbine pumps, and a silver medal for high-service pumps, shown in its exhibit in the Palace of Machinery.

The jury of awards of the Panama-Pacific Exposition has awarded a grand prize to the SOUTHERN PACIFIC CO., for its display of equipment in the Palace of Transportation.

Merton A. Pocock has been appointed district sales manager for the TERRY STEAM TURBINE CO., with headquarters at 400 Endicott building, St. Paul, Minnesota. His territory will include the states of Minnesota, North Dakota, and South Dakota.

The MARION STEAM SHOVEL CO. and the MARION-OSGOOD CO., of Marion, Ohio, have announced that the litigation that has been pending between the two companies for several years past, has been satisfactorily and amicably adjusted. This settlement covers all machinery heretofore shipped by the Marion-Osgood company, and grants to them, shop-rights to continue the use of the patents held by the Marion Steam Shovel company which are involved in the construction of the Marion-Osgood company's machines.

Catalogues Received

BROWNHOIST SHNABLE PATENT DRAG-LINE BUCKET. The Brown Hoisting Machinery company, Cleveland, Ohio. Describes and gives sizes of this drag-line bucket recently introduced by the Company. P. 12. Illustrated.

STREET LIGHTING BRACKETS AND CENTRE-SPAN FIXTURES FOR MAZDA LAMPS. The General Electric company, Schenectady, New York. Describes the different lighting-fixtures and gives light-distribution curves for a number of them. P. 44. Illustrated.

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